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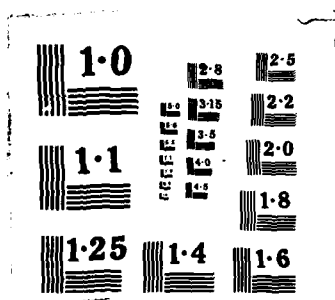
PORT EVERGLADES SHALLOW WATER RANGE AS-BUILT
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WASHINGTON DC CHESAPEAKE DIV JAN 81... 85 DEC 85
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ISSUE DATE
MAR 10 1981

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SHALLOW WATER RANGE
AS-BUILT DOCUMENTATION

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The Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENG-
COM) was tasked to construct an array of sensors at the naval Surface Weapons
Center (NSWC) Facility, Ft. Lauderdale, Florida. This installation is a part
of the Linear Chair Program. CHESNAVFACENGCOM's responsibilities (Con't)
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included the design, procurement, and installation of all system hardware except sensors and associated electronics. This Command, with major participation by the Civil Engineering Laboratory, designed and procured pressure vessels for housing the in-water sensors and electronics, foundations for mounting and aligning same, interconnecting cable, shore cable, and the shore facility for housing electronic equipment. This As-Built Documentation describes the installed hardware and the construction hardware for the underwater portion of the system that was developed to meet the sponsor's specifications.

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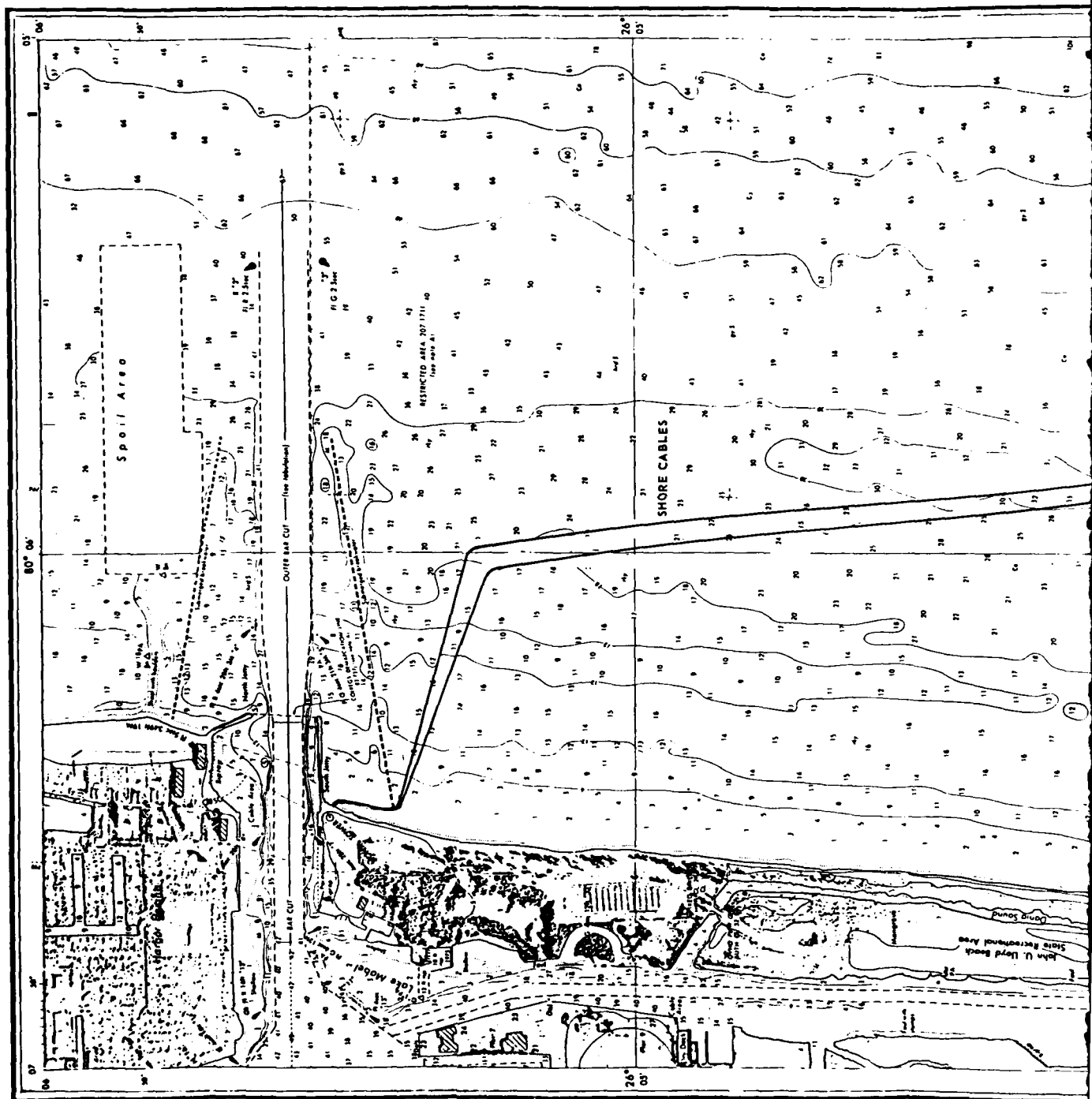
1.0 SHALLOW WATER RANGE OVERVIEW

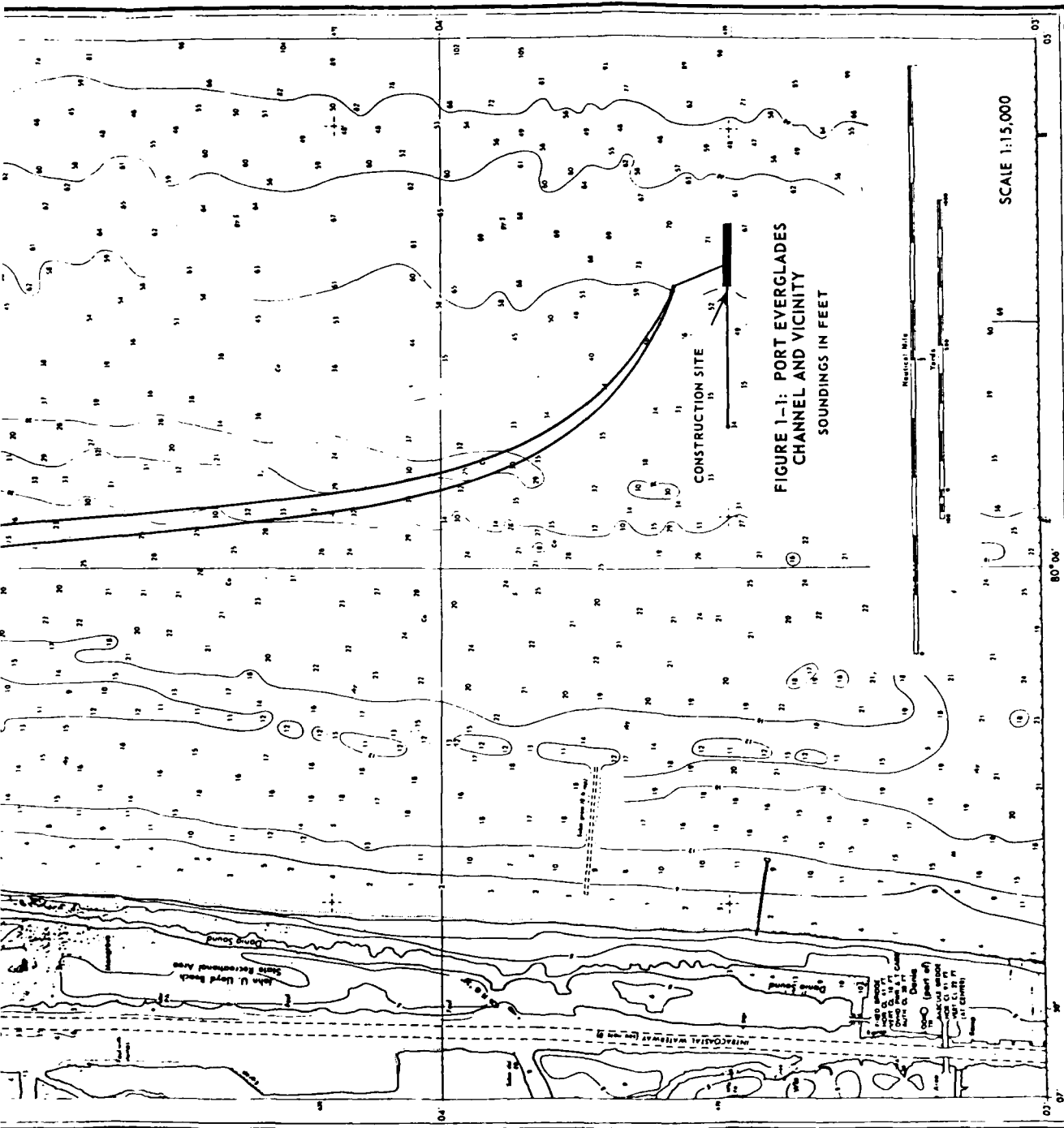
The Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM) was tasked to construct an array of sensors at the Naval Surface Weapons Center (NSWC) Facility, Ft. Lauderdale, Florida. This installation is a part of the Linear Chair Program. CHESNAVFACENGCOM's responsibilities included the design, procurement, and installation of all system hardware except sensors and associated electronics. This Command, with major participation by the Civil Engineering Laboratory, designed and procured pressure vessels for housing the in-water sensors and electronics, foundations for mounting and aligning same, interconnecting cable, shore cable, and the shore facility for housing electronic equipment. This As-Built Documentation describes the installed hardware and the construction hardware for the underwater portion of the system that was developed to meet the sponsor's specifications.

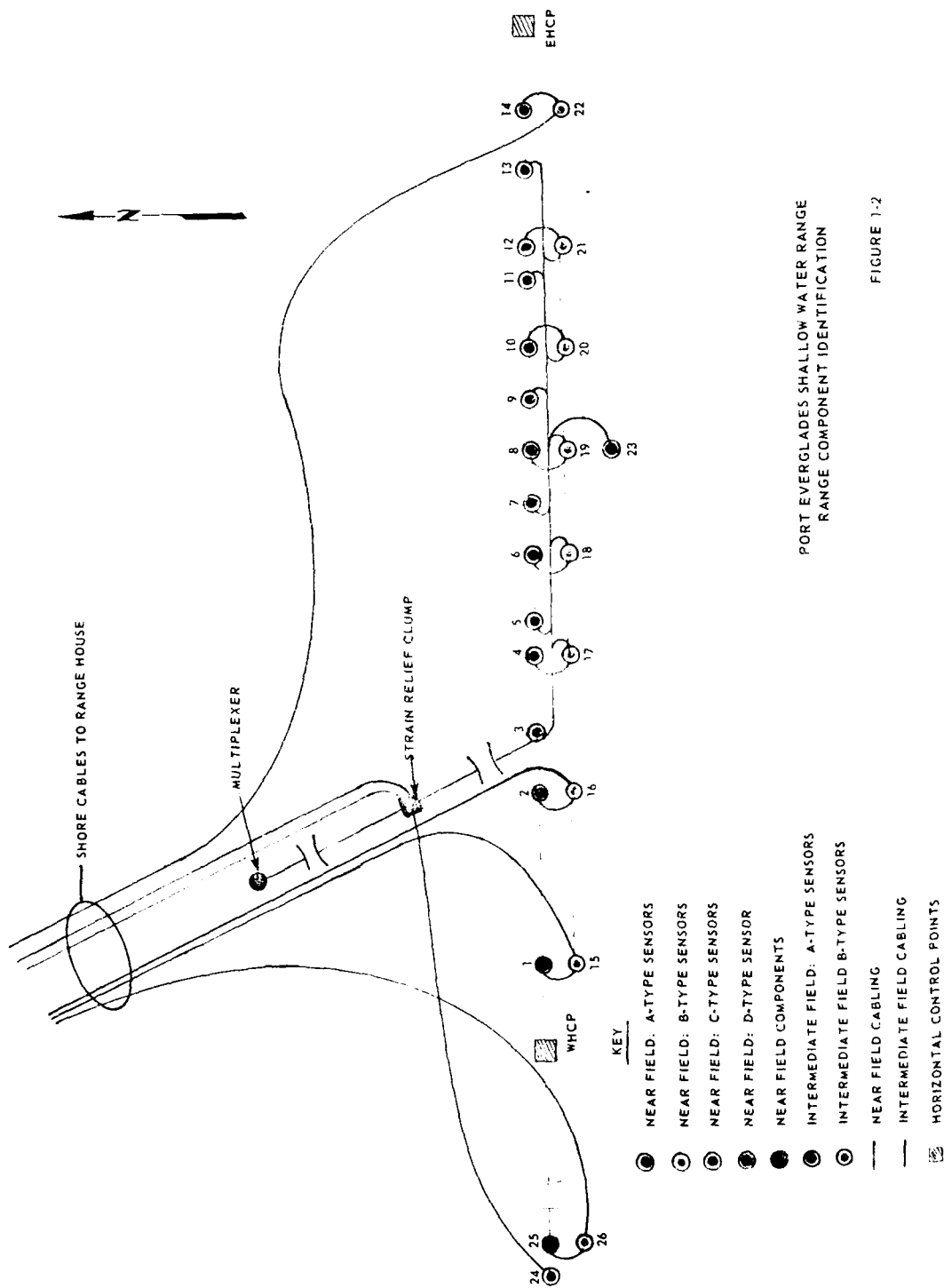
The range comprises some 26 sensors that are installed in precise positions along parallel lines 20 feet apart; these lines run east and west relative to the magnetic lines of force in the range area. The range is centered approximately 1.1 nautical miles offshore of the Florida coastline, just north of the Dania pier as shown in Figure 1-1. As indicated, the shore cables run from the construction site north to the NSWC jetty facility at Ft. Lauderdale where they terminate in a Data Van.

As presently installed, the range consists of two major sections: a near field range and an intermediate field range. The near field range comprises 18 sensors of four different types and the intermediate field range comprises 8 sensors of two different types. The two shore cables shown in Figure 1-1 are Type 201 Coax and they service the near field range; one cable providing power and the other transmitting multiplexed signals back to the Data Van. North of the lines of sensors these cables are secured to a strain relief clump and thence lead to a multiplexer box. From the multiplexer (MUX) box a harness channels power and signal cables to the 18 sensors of the near field range as shown in Figure 1-2.

Also shown are the intermediate field components and the associated shore cabling. Each of the four pairs of intermediate field sensors has a separate multiplexer unit and thus a single power/signal cable services each of these sensor pairs.







PORT EVERGLADES SHALLOW WATER RANGE
RANGE COMPONENT IDENTIFICATION

FIGURE 1-2

The majority of the installed hardware was required to be of non-magnetic material. As a result, extensive use was made of concrete, plastics, and wood. Additionally, there was a requirement that the sensor spacing and alignment be extremely precise; this called for very exact measurements of sensor locations and the support of the sensors in a vertical orientation on a solid mounting base that would permit neither vertical, horizontal nor angular movement despite variations in environmental conditions. These requirements called not only for specialized installed hardware but also for many special installation tools, jigs, and fixtures to ensure the proper alignment, spacing, and location.

In addition to the requirement for a high degree of installation precision there was imposed a very limited time frame in which to devise, design, and procure the necessary hardware. Time did not permit the preparation of detail and assembly drawings of all parts to be fabricated and often it was necessary for the design engineer to convey verbal instructions to shop personnel in order to get the components built on time. Similarly, hardware changes made on site during the ocean construction phase could not always be thoroughly documented. Thus, the "as-built" drawings contained herein are not in the usual form but consist mainly of sketches from which the hardware was built. For reporting purposes, some of the assembly drawings have been completely reworked; in other cases drawings, in orthogonal projections and perspective form, have been extracted from the Construction Operations Plans that were prepared for this project. The remainder of the drawings are basically those from which the hardware was fabricated with some slight enhancement to improve the clarity of third or fourth copies of the original drawings. The large majority of these original drawings were the work of J. Wilson of the Civil Engineering Laboratory.

The physical layout of the shallow water range array, including coordinates of all of the various sensors, is given in Figure 1-3. These coordinates for the sensors are distances in feet East and North (magnetic) of the West Horizontal Control Point (WHCP). They may be related to either the Florida Grid or to geographic coordinates by reference to the location of basic system elements given in the lower left corner of the layout.

The East and West Horizontal Control Points were surveyed-in with reference to theodolites at three shore stations and the control point

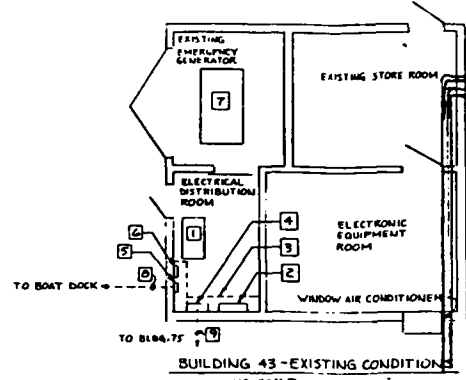
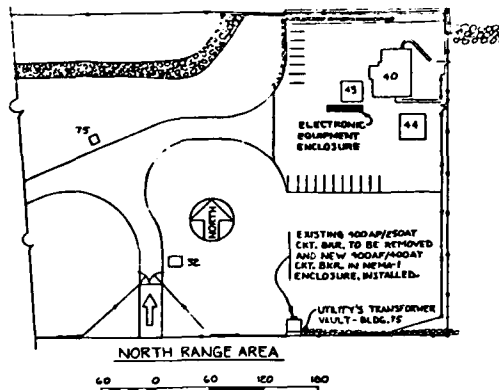
locations were determined with great precision. A tensioned line called the Horizontal Control Line (HCL) was stretched between the WHCP and the EHCP to serve as a reference for placing the sensors in position and for determining their exact location after installation. The installation techniques and hardware devised for this purpose are described in Section 6.0 of this report.

2.0 SHORE FACILITY

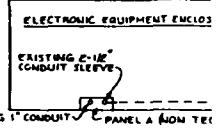
The heart of the shore facility for the Port Everglades Shallow Water Range is an electronics equipment enclosure, or *Data Van*, that is located on the property of the NSWC jetty facility at Ft. Lauderdale. The location of the Data Van relative to other buildings at this facility is shown in the upper left corner of Figure 2-1.

The Data Van is essentially a 40-foot container that houses a computer and to which all range shore cables are connected. Figure 2-1 diagrams the electrical installation required for powering this facility and Figure 2-2 shows the Data Van layout; details of the cable penetrations are given in Figure 2-3. Electrical diagrams for lighting and power are given in Figure 2-4. Figures 2-5 and 2-6 show the electrical and refrigerant schematics respectively for the Data Van air conditioning system.

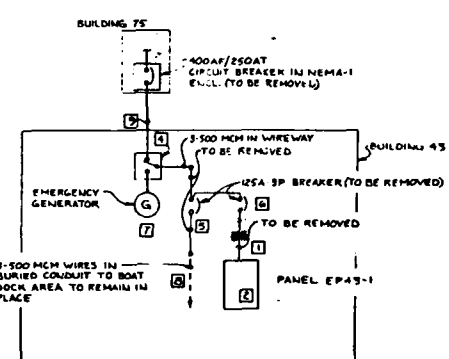
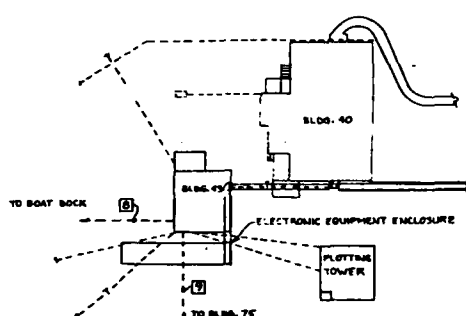
For navigation in laying shore cables and in precise positioning of the range elements, both a Mini-Ranger system and triangulation by theodolites at fixed points along the shoreline were used. The primary stations were a lookout tower at the base of the jetty on the NSWC facility property and a lookout tower south of the array in Dania. The former was designated *SIGNAL* and the latter was designated *LOOK*. Both the Florida Grid Coordinates and the geographic coordinates of these two stations are given in Figure 1-3. Additional details of the location of these stations relative to National Geodetic Survey (NGS) Triangulation Stations are given in the surveyor's report, Figure 2-7.



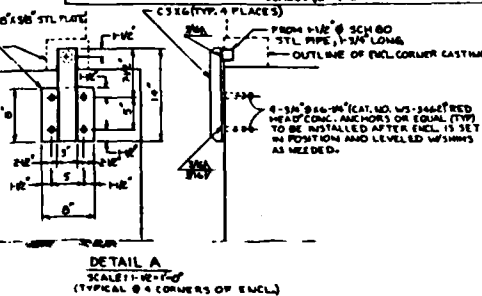
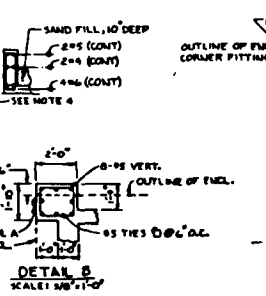
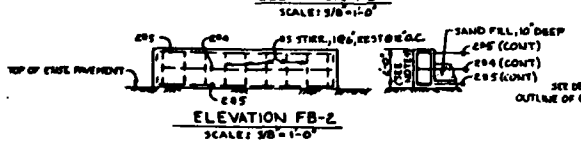
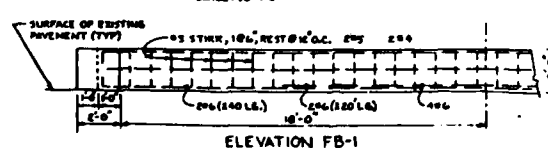
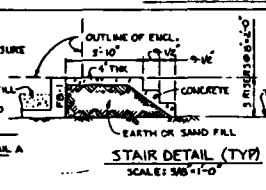
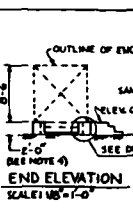
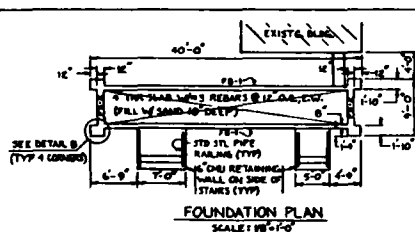
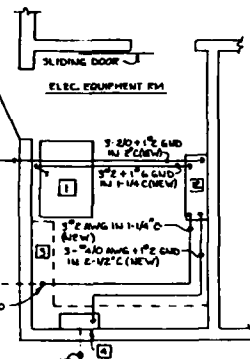
NEW 24-26 WIRES IN 3" CONDUIT -
NEW 200A-3P-240V SW. IN NEMA-1 ENCLOSURE

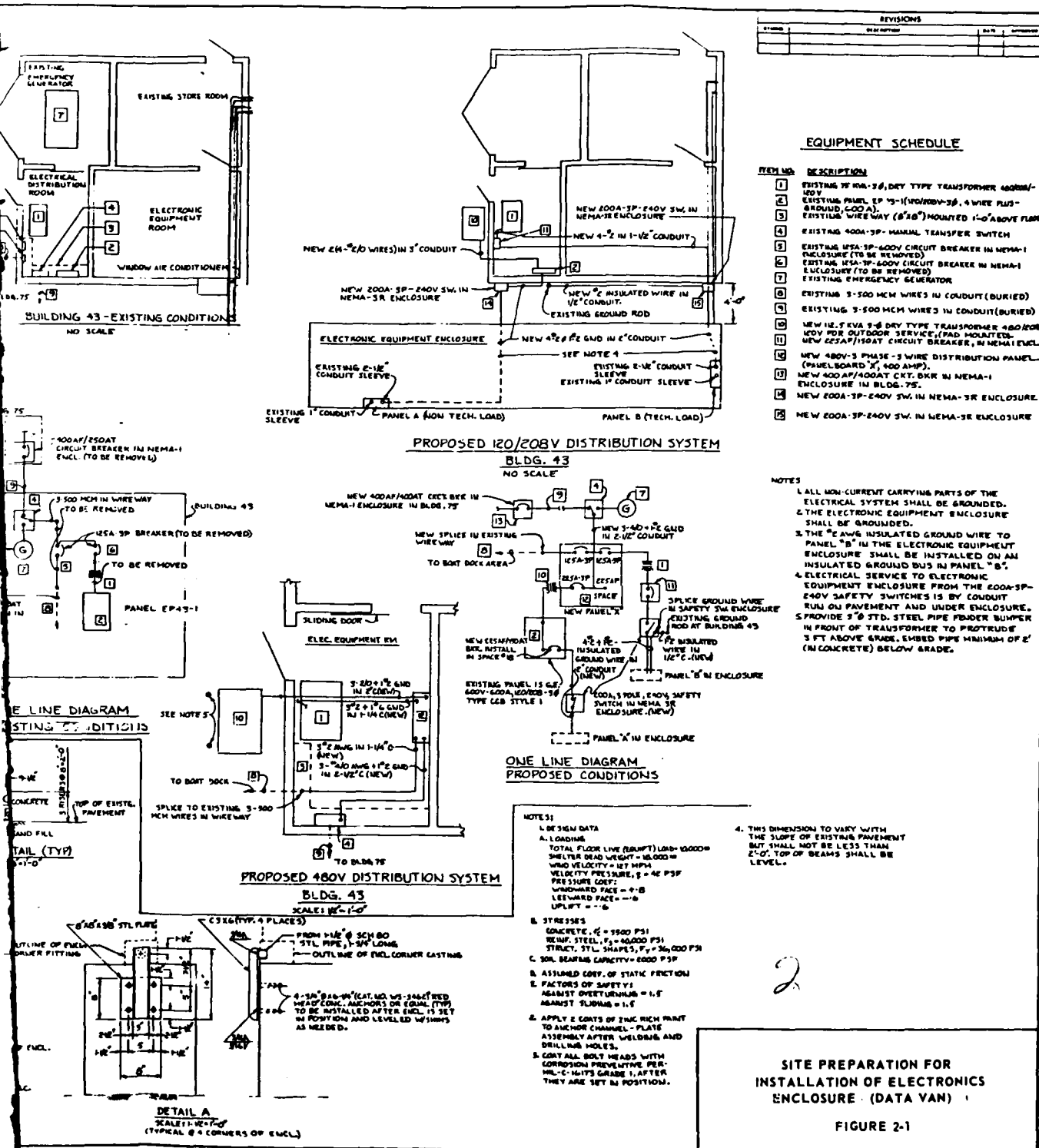


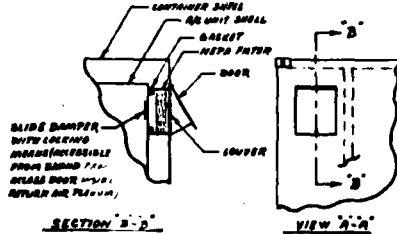
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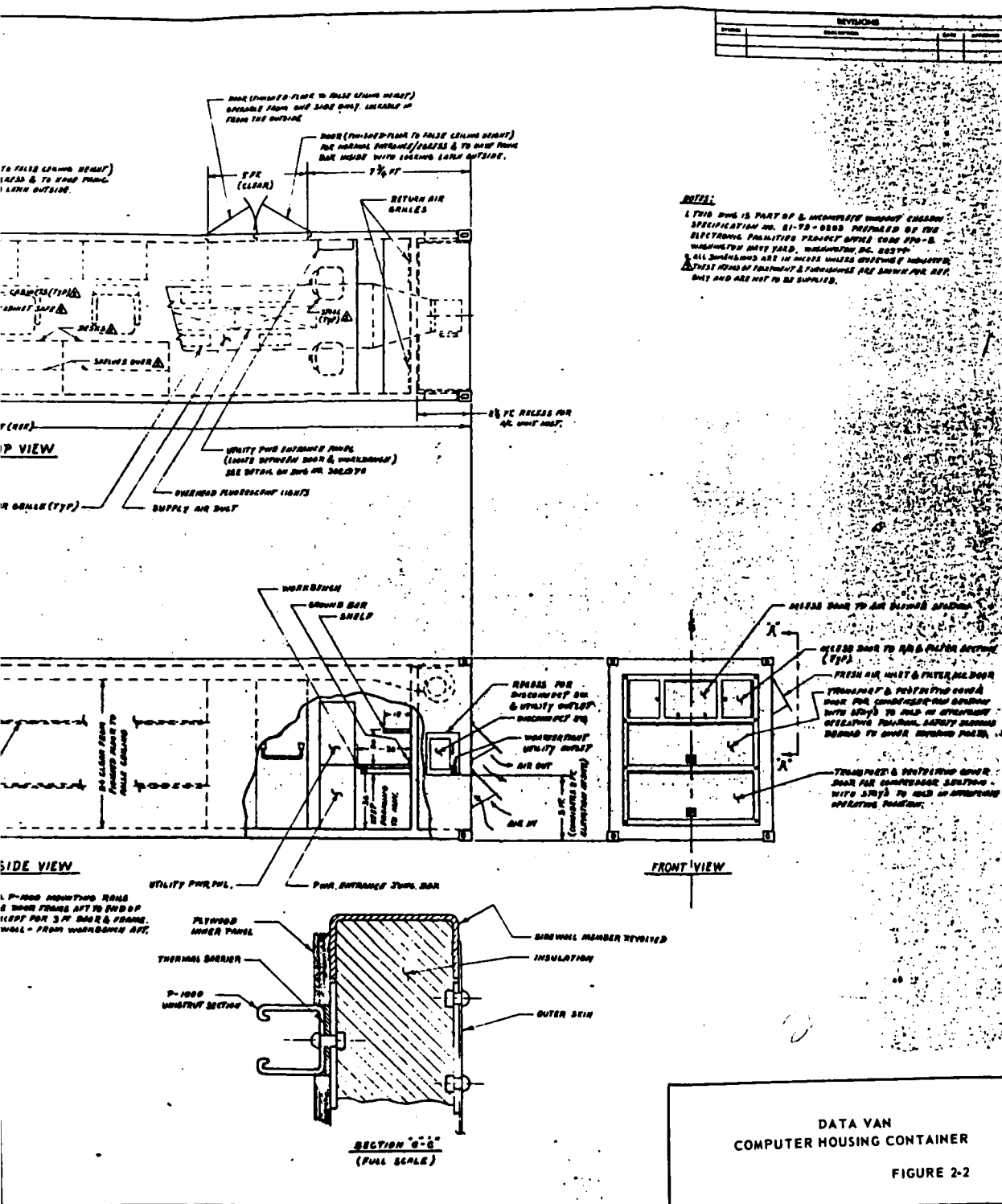


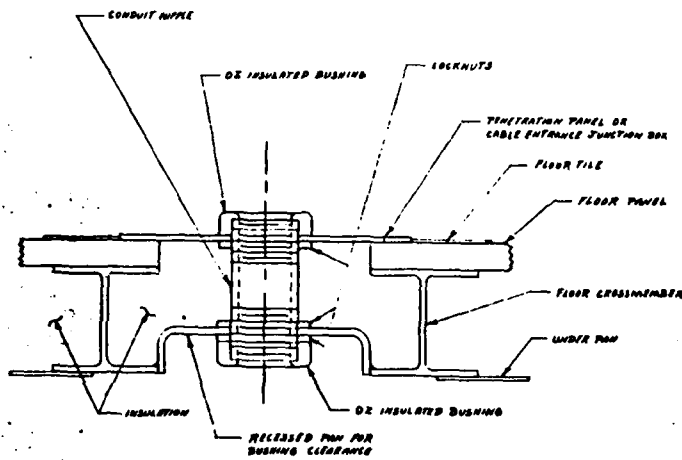
NEW 400A/250A CIRC. BRK. IN NEMA-1 ENCLOSURE IN BLDG. 75
NEW SPICE WIREWAY TO BOAT



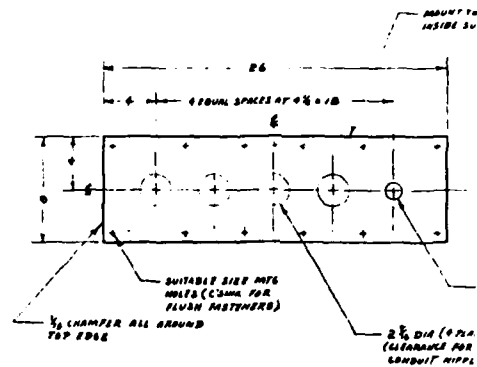




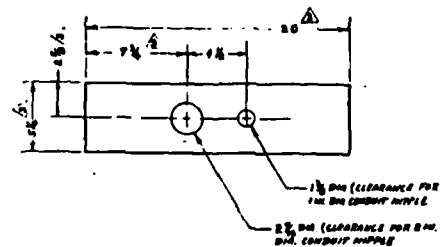




TYPICAL CABLE PENETRATION
SCALE - NONE

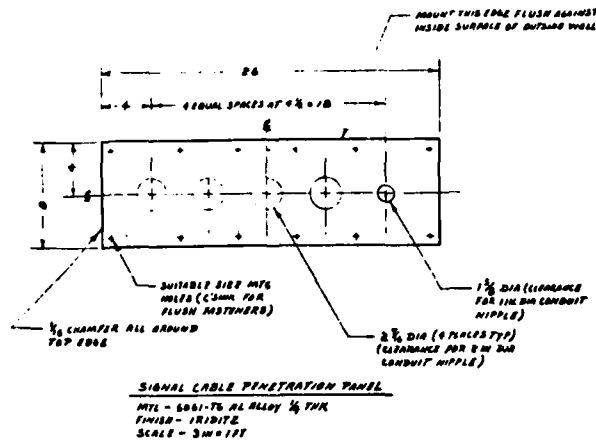


SIGNAL CABLE PENETRATION PANEL
MTL - 6061-T6 AL ALLOY 1/4 THK
FINISH - IRIDITE
SCALE - 3/16" = 1 FT

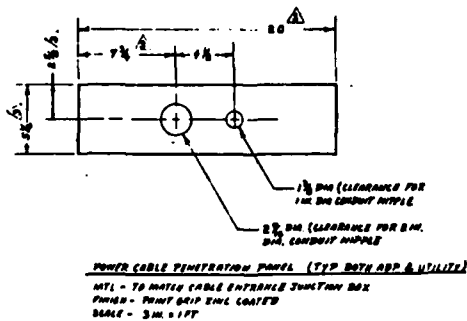


POWER CABLE PENETRATION PANEL (TYP BOTH APP. 6.11)
MTL - 70 MATCH CABLE ENTRANCE JUNCTION BOX
FINISH - PAINT GRIP ENL COATED
SCALE - 3/16" = 1 FT

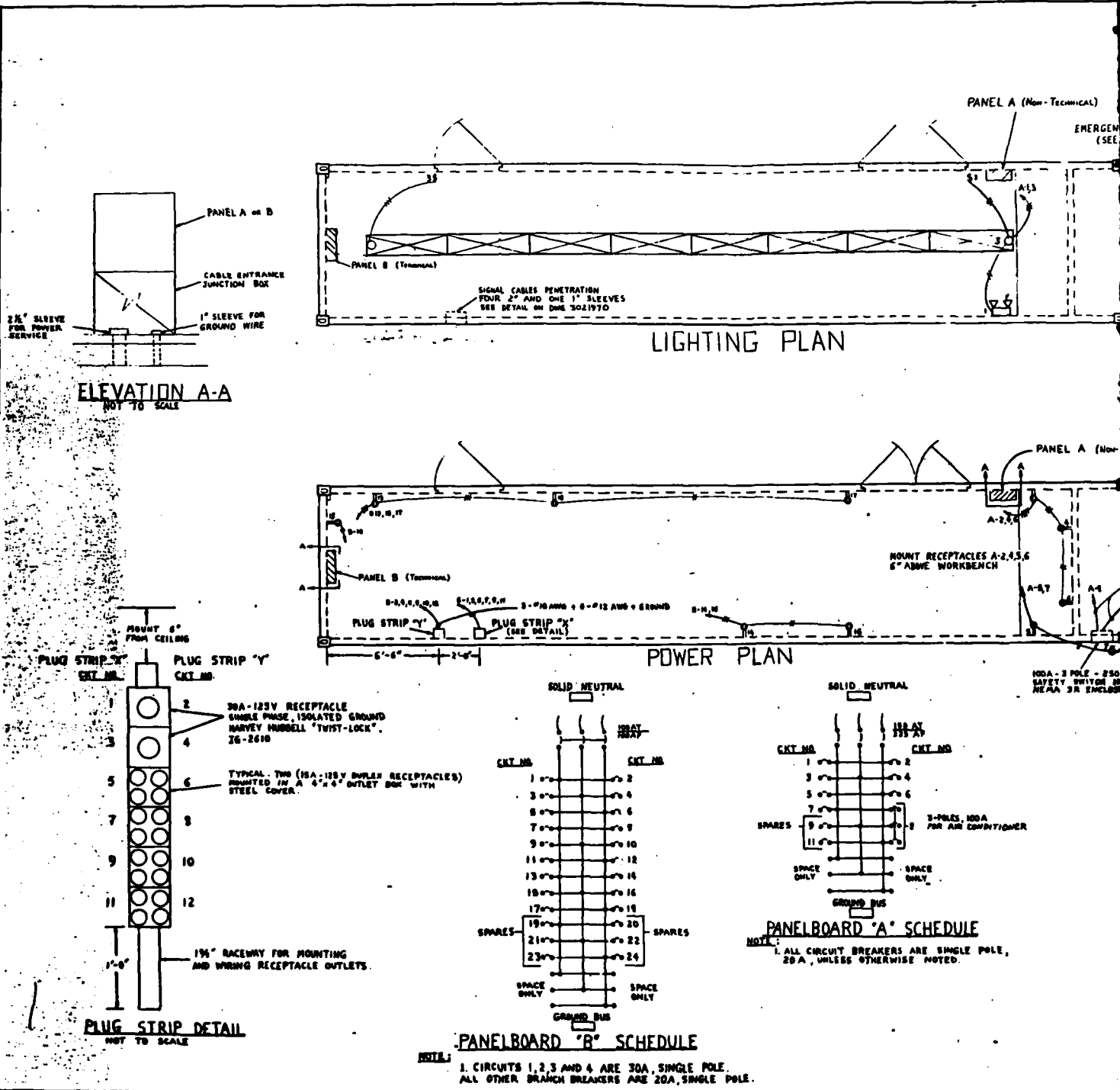
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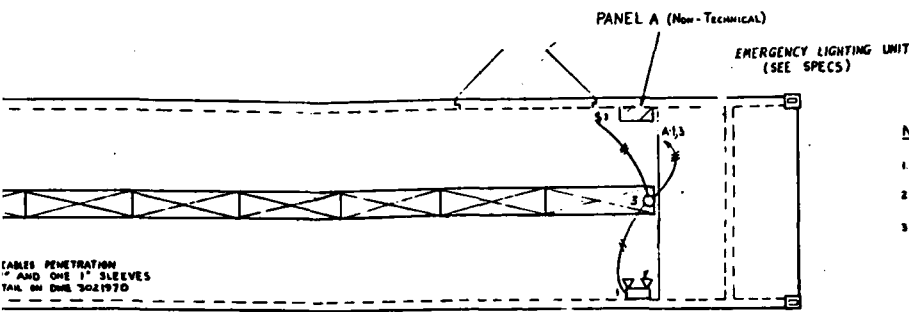
- NOTES:
1. SEE DWA NO. 308186 FOR INSTALLATION OF THE DETAILS SHOWN ON THIS DWG.
 2. TOLERANCE - $\pm 1/32$ UNLESS OTHERWISE INDICATED
 3. THESE DIMENSIONS MAY BE VARIOUS TO SUIT CABLE ENTRANCE JUNCTION BOX WHICH IN TURN MUST MATCH DIMENSIONS OF POWER DISTRIBUTION PANEL



DATA VAN
COMPUTER HOUSING DETAILS
FIGURE 2-3



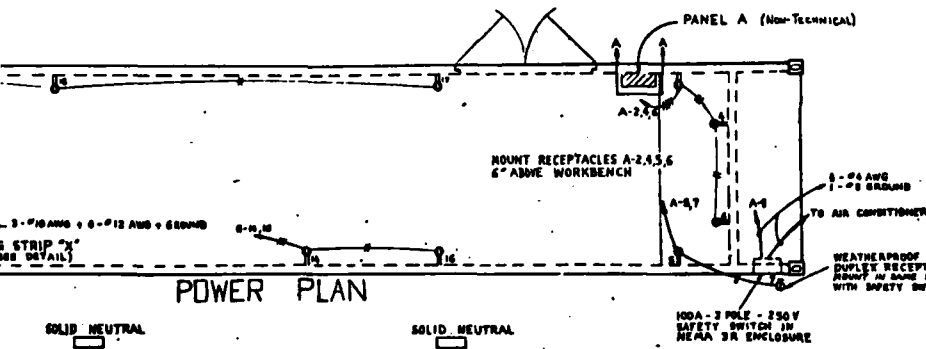
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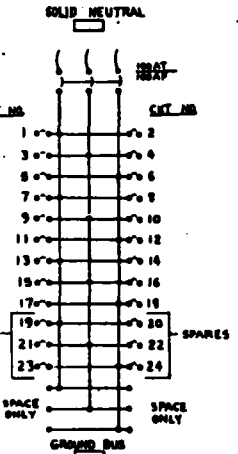
LIGHTING PLAN

NOTES:

1. ELECTRICAL SERVICE WILL BE 120/208 VOLTS, 3-PHASE 4-WIRE PLUS GROUND
2. ALL NON-CURRENT CARRYING PARTS OF THE ELECTRICAL SYSTEM SHALL BE GROUNDED
3. NUMBER NEXT TO OUTLET REFERS TO CIRCUIT NUMBER ON PANELBOARD.

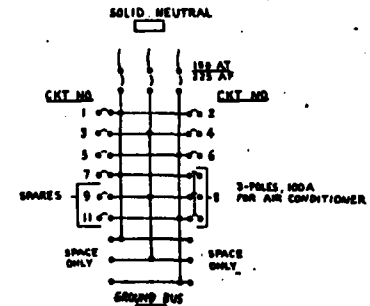


POWER PLAN



BOARD 'B' SCHEDULE

1, 2, 3 AND 4 ARE 30A, SINGLE POLE.
ALL OTHER BRANCH BREAKERS ARE 20A, SINGLE POLE.



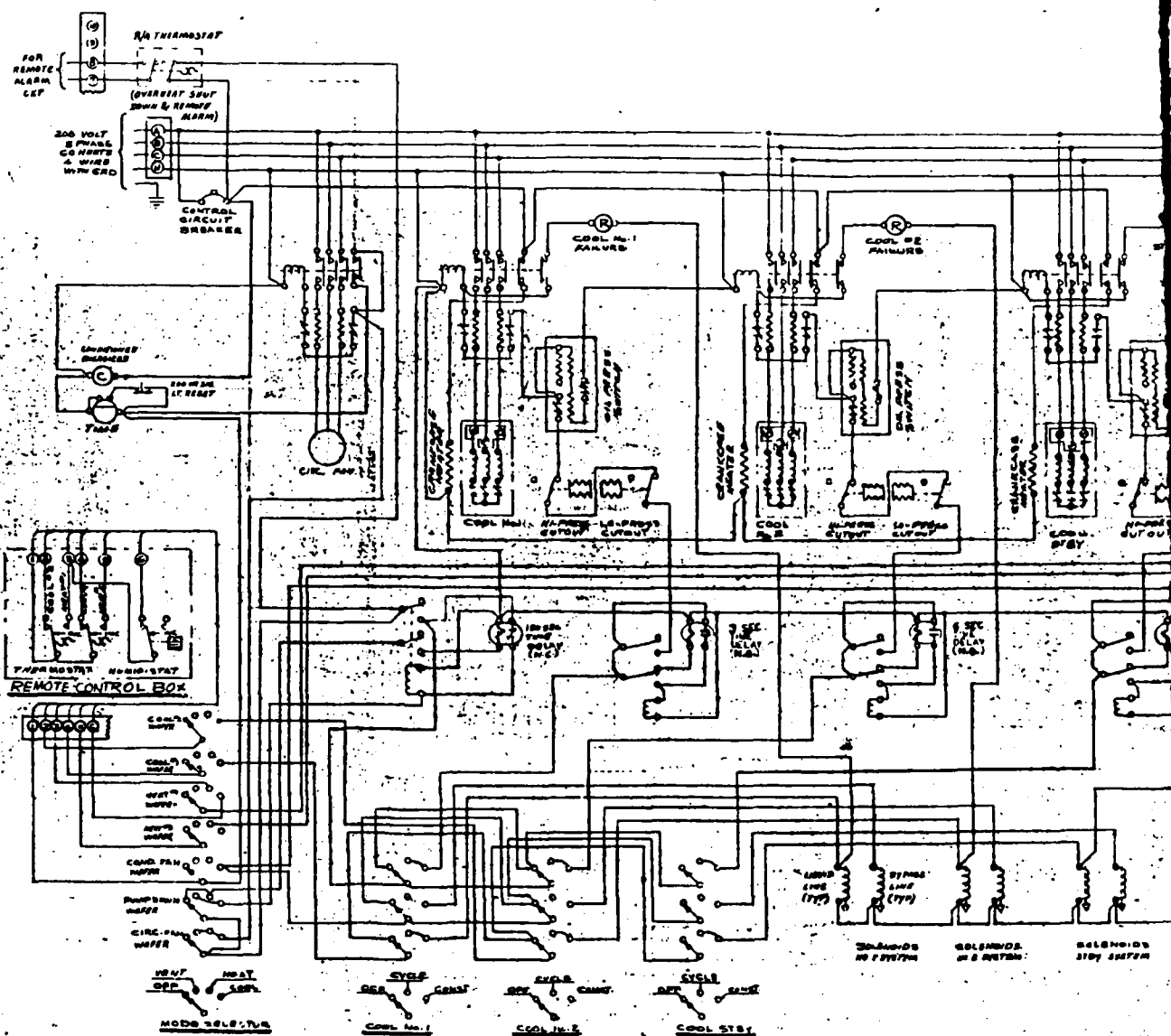
PANELBOARD 'A' SCHEDULE

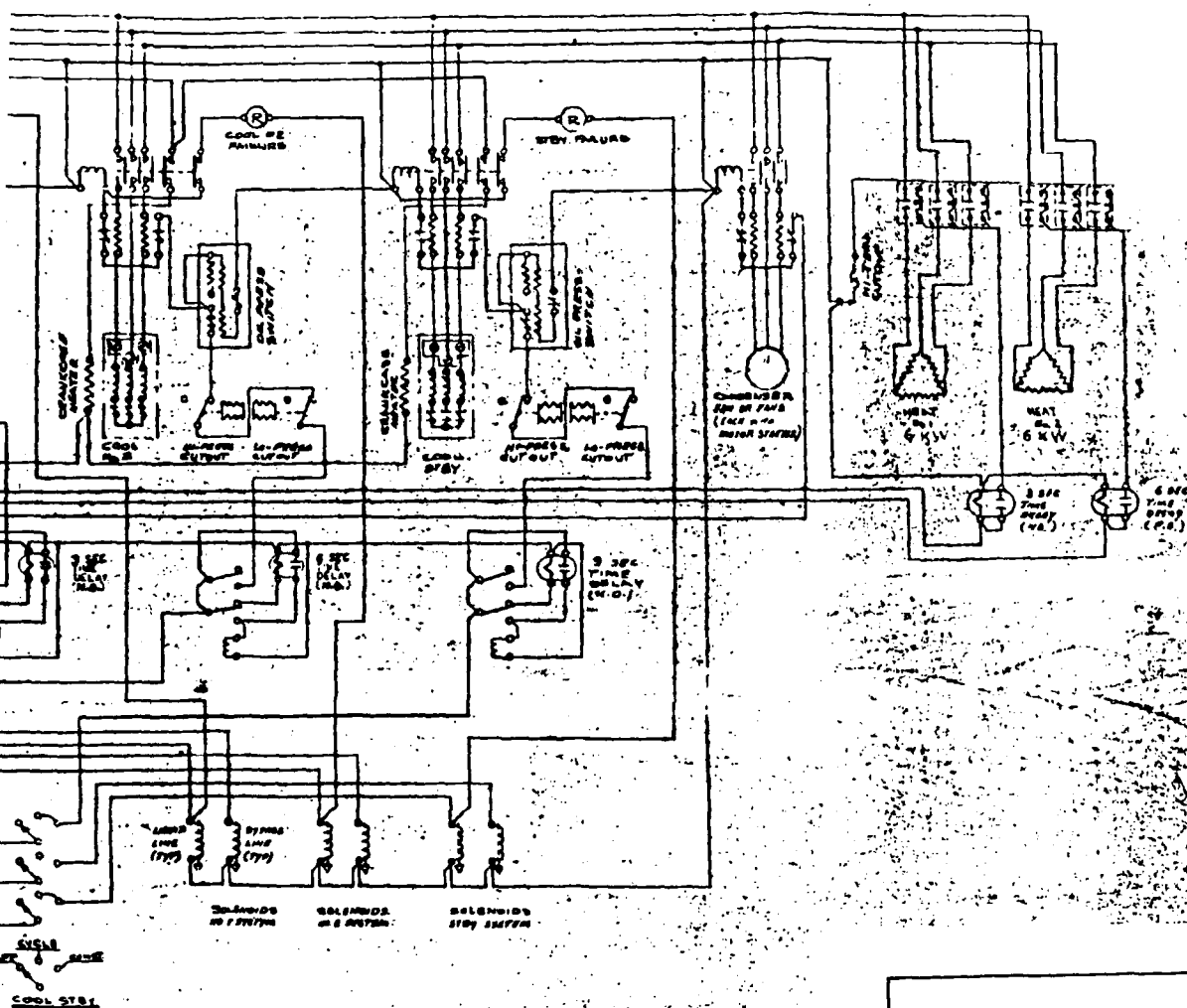
NOTE: ALL CIRCUIT BREAKERS ARE SINGLE POLE, 20A, UNLESS OTHERWISE NOTED.

LEGEND:

- 4'-0" - 2 LAMPS FLUORESCENT FIXTURE
- 15A, 125V, 3-WAY TOGGLE SWITCH
- TWO - 15A, 125V DUPLEX RECEPTACLES IN A 4" SQUARE OUTLET BOX, MOUNT 1'-0" ABOVE FLOOR, UNLESS OTHERWISE NOTED.
- CONDUIT, WIREWAY OR RACEWAY. SLANT LINES DENOTE NUMBER OF #12 AWG WIRES, UNLESS OTHERWISE NOTED. (GROUND WIRE IS NOT SHOWN)

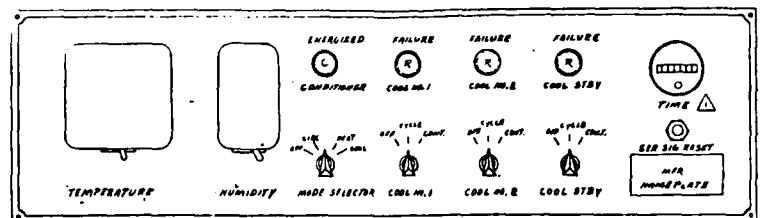
DATA VAN
ELECTRICAL PLAN
FIGURE 2-4



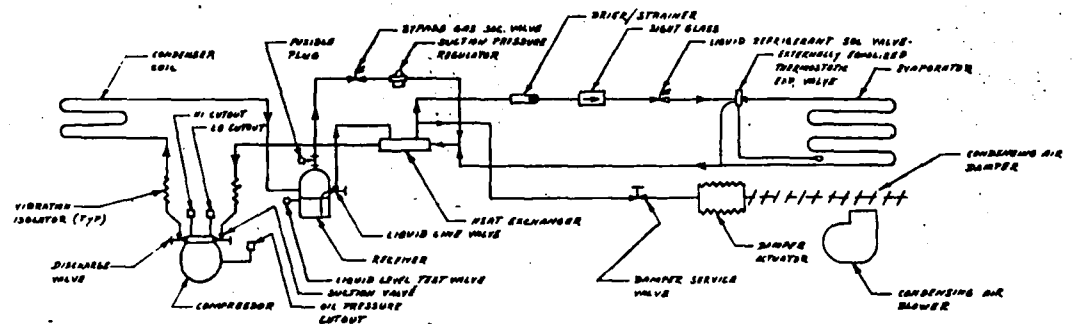


DATA VAN
ELECTRICAL SCHEMATIC FOR A/C UNIT

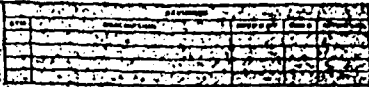
FIGURE 2-5



REMOTE CONTROL PANEL



REFRIGERANT SCHEMATIC



⚠ RUNDOWN TIME AFTER TO BE THE SERVICE-ON-SIGNAL, BROWN TYPE.

⚠ ONLY ONE REFRIGERANT CIRCUIT ON A MOUNTING CIRCUIT UNIT IS SHOWN, OTHER CIRCUITS ARE IDENTICAL.

DRIFT STRAINER

MOUNT GLASS

LIQUID REFRIGERANT SOL. VALVE

THERMOSTATIC EXP. VALVE

COMPRESSOR

CONDENSING AIR DAMPER

SHIMME ACTUATOR

DAMPER SERVICE VALVE

COIL EXCHANGER

CONDENSING AIR DAMPER

GERANT SCHEMATIC (B)

FIGURE 2-6

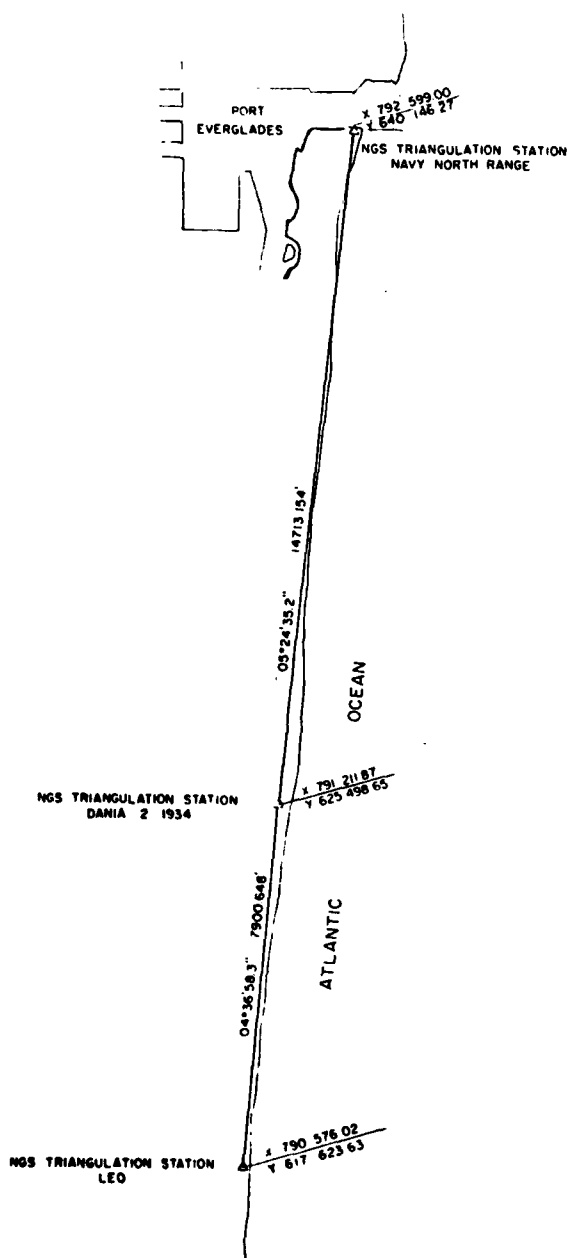
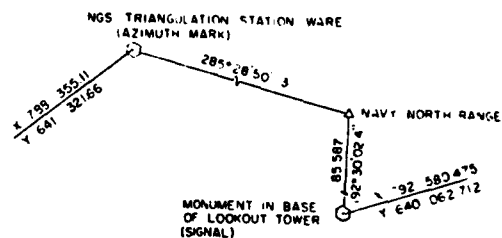
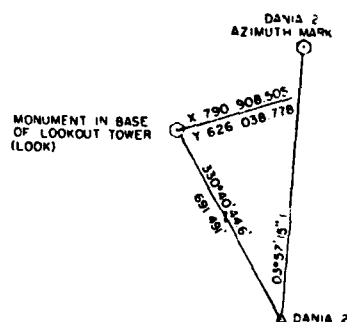


DIAGRAM OF TRIANGULATION STATIONS

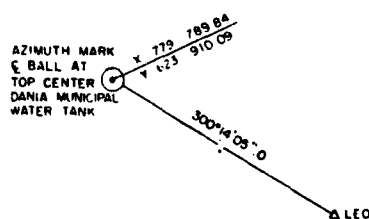


DETAIL AT NAVY NORTH RANGE
NOT TO SCALE

NGS - NATIONAL GEODETIC SURVEY



DETAIL AT DANIA 2
NOT TO SCALE



DETAIL AT LEO
NOT TO SCALE

SURVEYOR'S REPORTED
LOOKOUT STATION LOCATIONS

FIGURE 2-7

3.0 SHORE CABLE AND HARNESS INSTALLATIONS

Near Field Shore Cable

The near field shore cable system consists of two parallel cables, running from the Data Van to a multiplexer unit located northwest of the sensor array. The distance between the Data Van and the multiplexer is approximately 2 1/4 nautical miles. The cable is Type 201 Coax, obtained from the NSWC Facility, in Ft. Lauderdale. NSWC, Ft. Lauderdale was tasked to install the shore cables under the supervision of CHESNAVFACENGCOM. NSWC utilized the R/V A.B. WOOD, RSB-1, and the existing range optical tracking system. The details of the shore cable installation are given in the Construction Operations Plan. The actual layout of the two near field shore cables is given in Figure 3-1. A temporary clump was installed approximately 250 feet from the seaward ends of the shore cables to secure the near field shore cables prior to installation of the permanent strain relief clump.

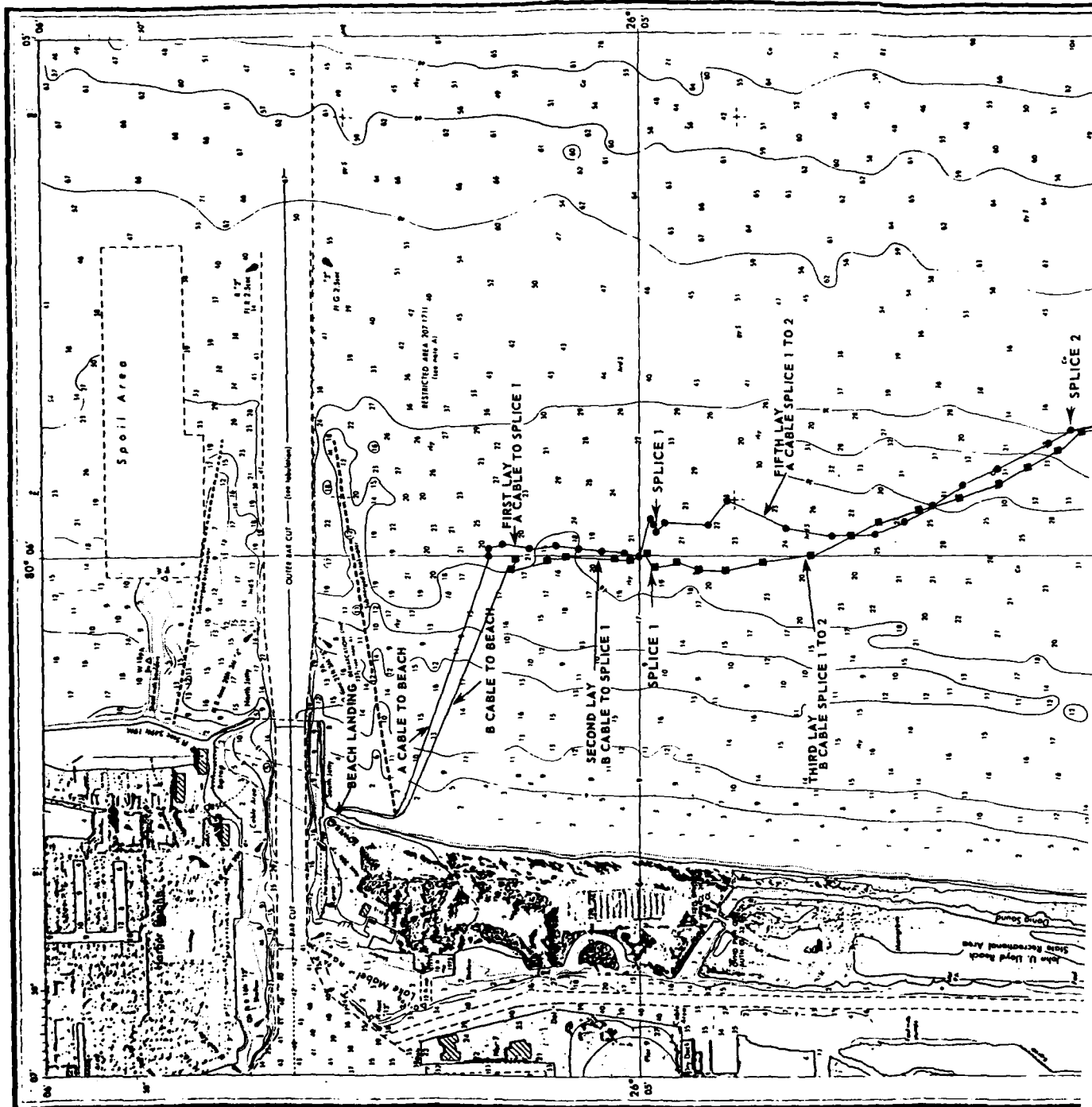
Intermediate Field Shore Cable

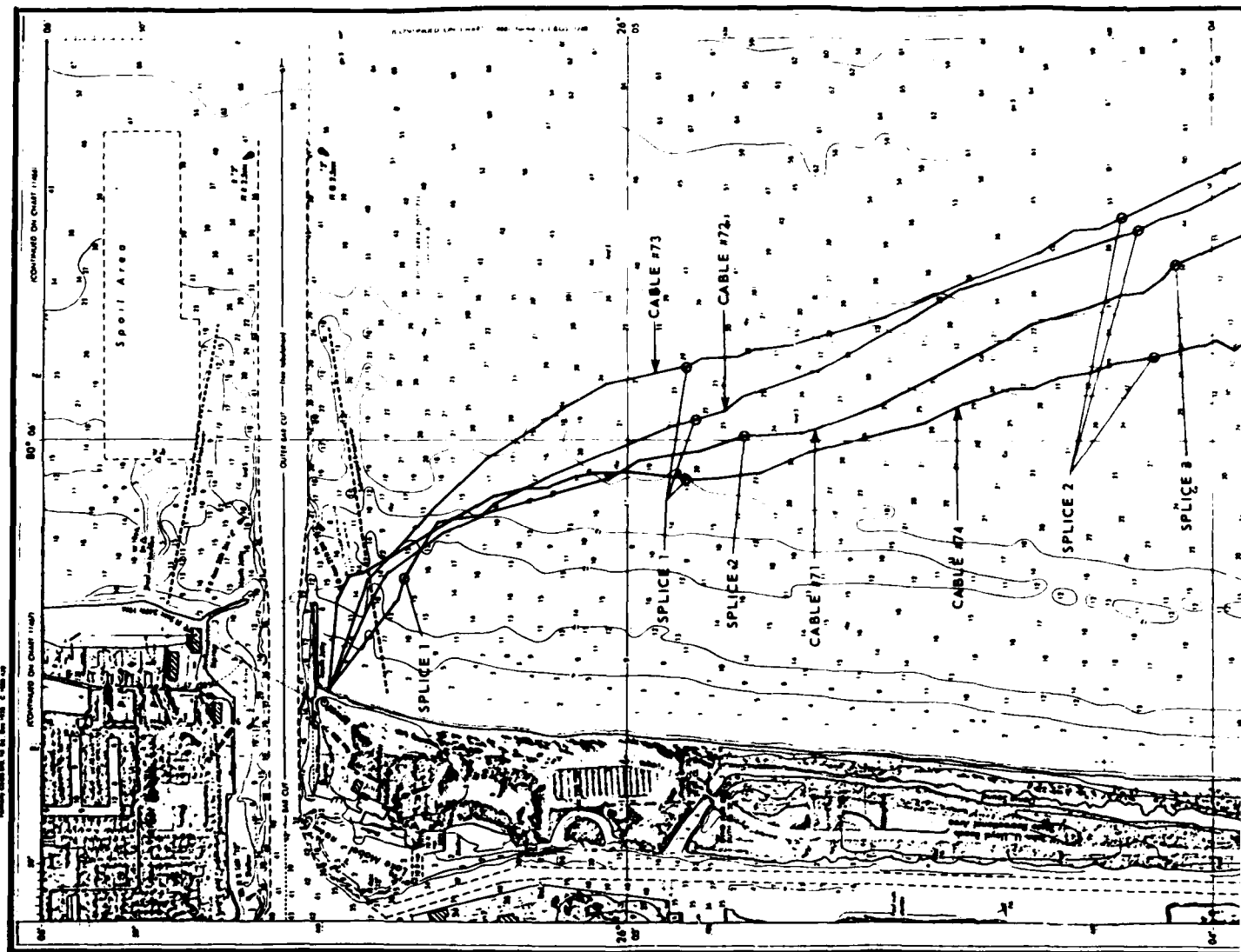
The intermediate field shore cables were installed at a later date using generally the same techniques and location methods as were used on the near field shore cables. These four cables are connected directly to the components contained in the foundations for sensors 22, 16, 15, and 26. Therefore, the cables were laid generally in the direction of these foundations and sufficient cable was left on the bottom to make the necessary connections. The cable layout for these four intermediate field cables is shown in Figure 3-2.

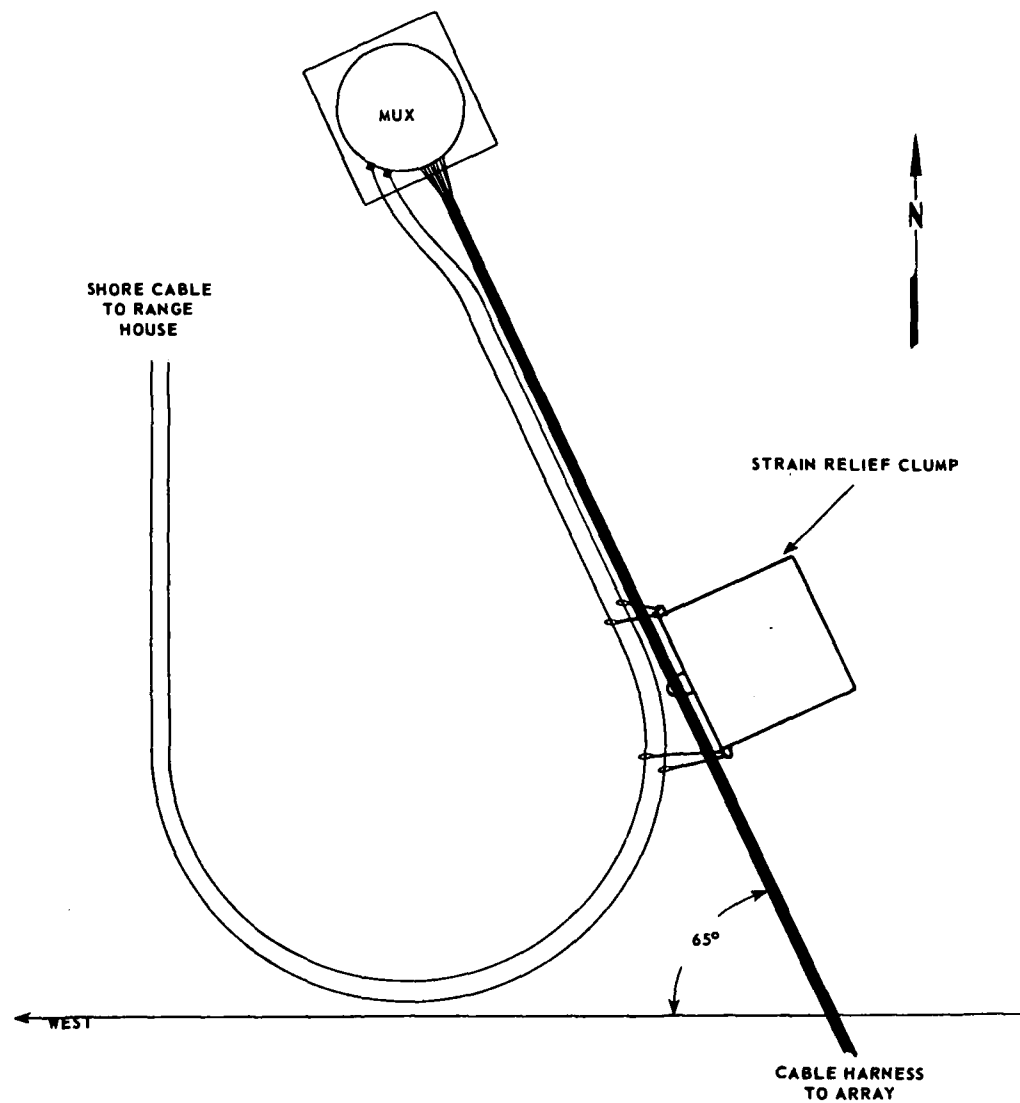
Near Field Strain Relief Clump and Multiplexer Box

The general arrangement of the near field multiplexer box and the strain relief clump, together with the corresponding cables and harness, is shown in Figure 3-3. Both of the shore cables and the harness are secured to the strain relief clump with the shore cables running from there to the multiplexer and the near field harness running from the multiplexer to the sensor foundations. Details of the strain relief clump are shown in Figure 3-4.

The foundation for the near field multiplexer box was fabricated in

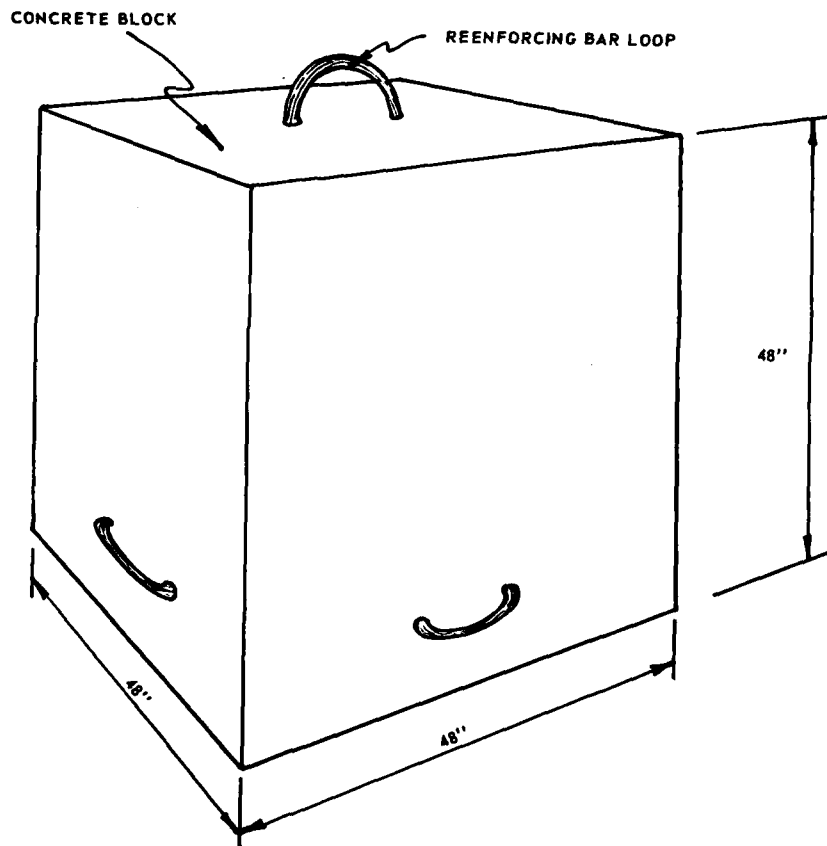






CABLE CONFIGURATION AT STRAIN RELIEF CLUMP

FIGURE 3-3



STRAIN RELIEF CLUMP

FIGURE 3-4

accordance with the sketches given in Figures 3-5 through 3-10. The multiplexer box (or housing) was fabricated in accordance with the drawings provided in Figures 3-11 and 3-12.

Near Field Cable Harness Arrangement

As shown in Figure 3-13 the cable harness from the multiplexer box runs past the strain relief clump to the southeast where, at sensor #3, it turns east and follows the horizontal control line to its termination at sensor #13. An 85 foot pendant was secured to the end of the harness. This pendant was secured to the EHCP and was used to help pull the harness into place between the lines of sensor foundations.

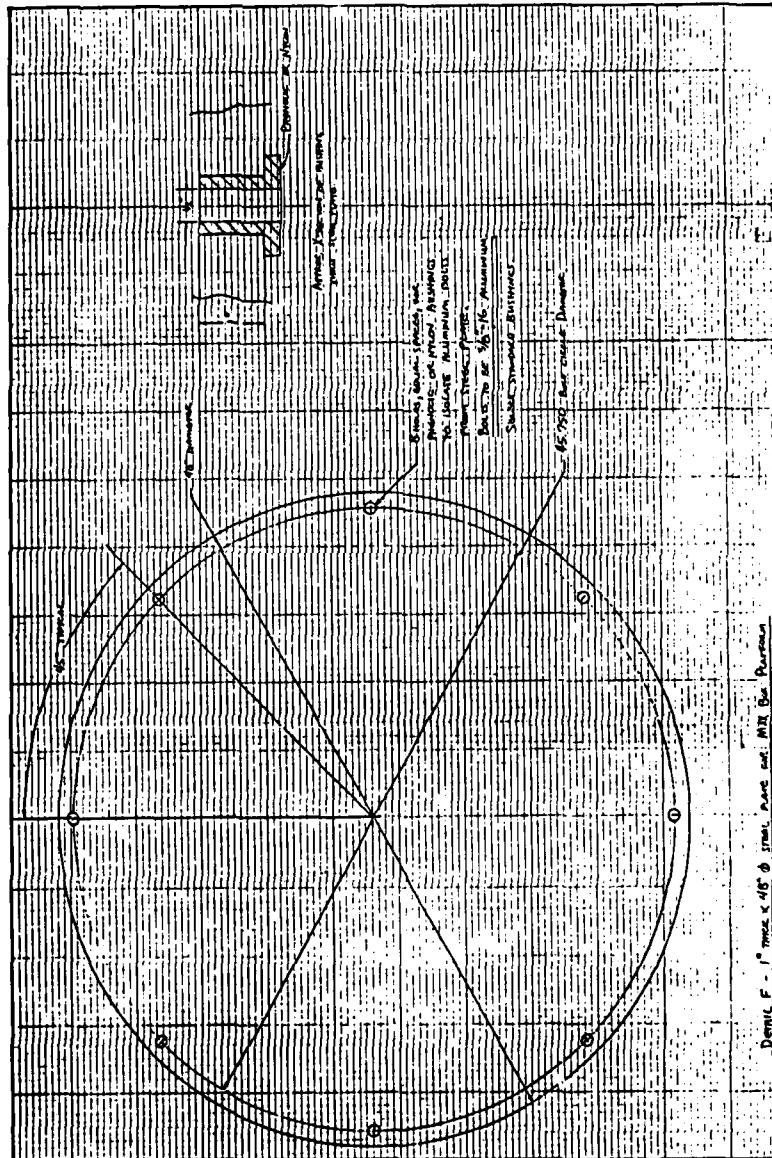
At the strain relief clump, one cable was stripped out of the harness and led west to sensor #24. Additional cables were stripped out along the line between sensor foundations to be connected to Type B sensors in foundations 17, 18, 19, 20, and 21, to Type C sensors in foundations 3, 5, 7, 9, 11, and 13, to the Type D sensor in foundation 23, and to the Type A sensor electronics units in foundations 17, 18, 19, 20, and 21.

Dimensional Layout of Array

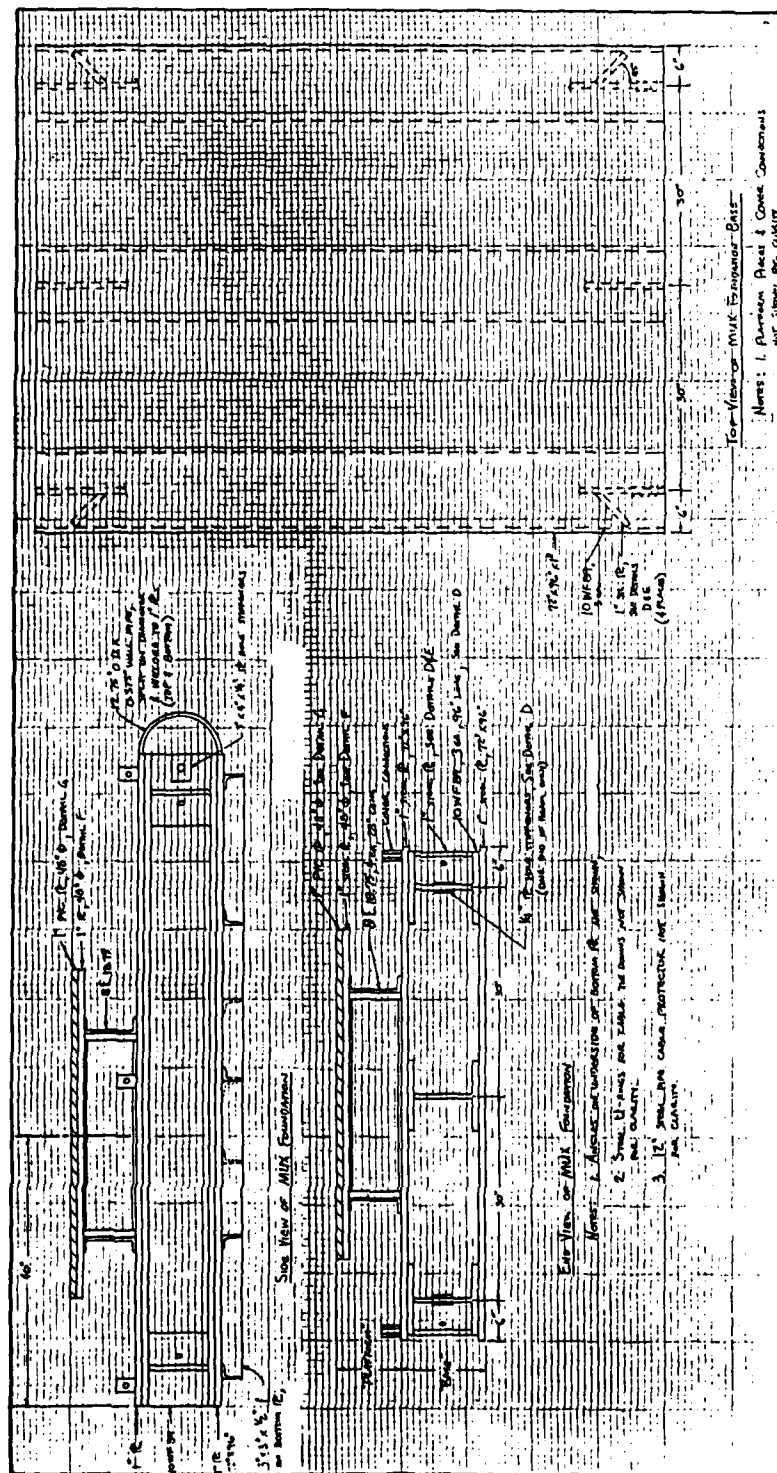
The planned layout of the array showing the dimensions between sensors and other array elements is given in Figure 3-14.

The near field array comprises all of those sensors from #3 on the west of the centerline to #13 on the east of the centerline plus sensor #24 which serves as a monitoring unit. The remaining sensors constitute the intermediate field.

The configuration and mounting arrangements for the various types of sensors employed will be described in another section of this report. However, some identification is necessary at this point in order to continue with the description of the cabling arrangement. Referring again to Figure 3-14, the nine pairs of sensors located 20 feet apart north and south of each other, i.e., #1 and #15, #2 and #16, etc., comprise Type A sensors along the horizontal control line with Type B sensors making up the other half of the pair. The remaining sensors along the horizontal control line, i.e., #3, #5, #7, etc., are Type C sensors. Sensor #23 is Type D sensor. Sensor #24 is a Type C reference sensor.



NEAR FIELD MULTIPLEXER FOUNDATION
STEEL PLATE BASE FOR PVC TOP PLATE
FIGURE 3-5



VIEWS OF NEAR FIELD MULTIPLEXER FOUNDATION

FIGURE 3-6

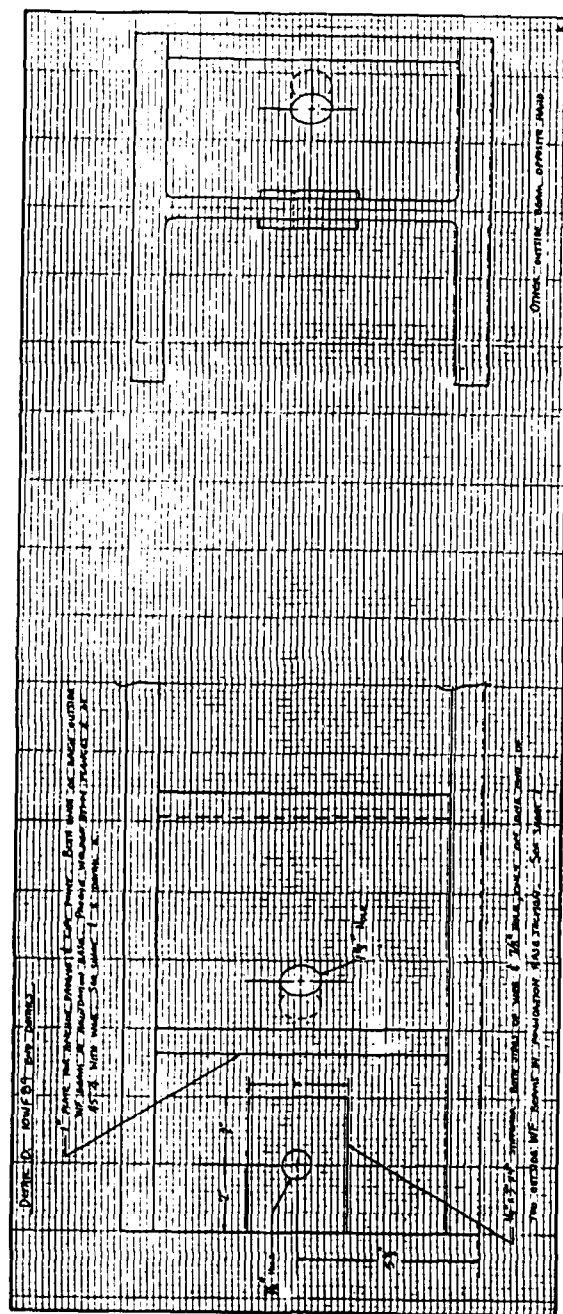
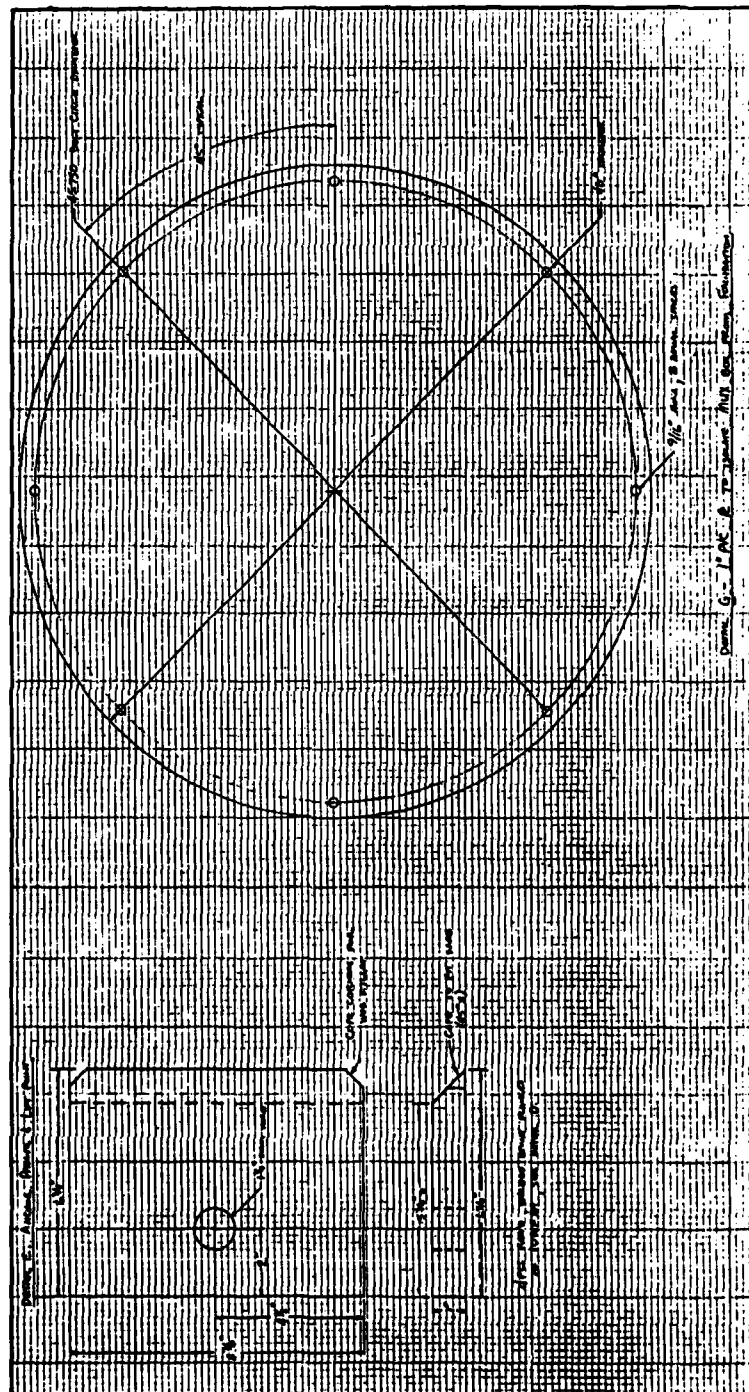


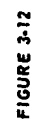
FIGURE 3-8



NEAR FIELD MULTIPLEXER FOUNDATION
ISOLATING TOP PLATE

FIGURE 3-10





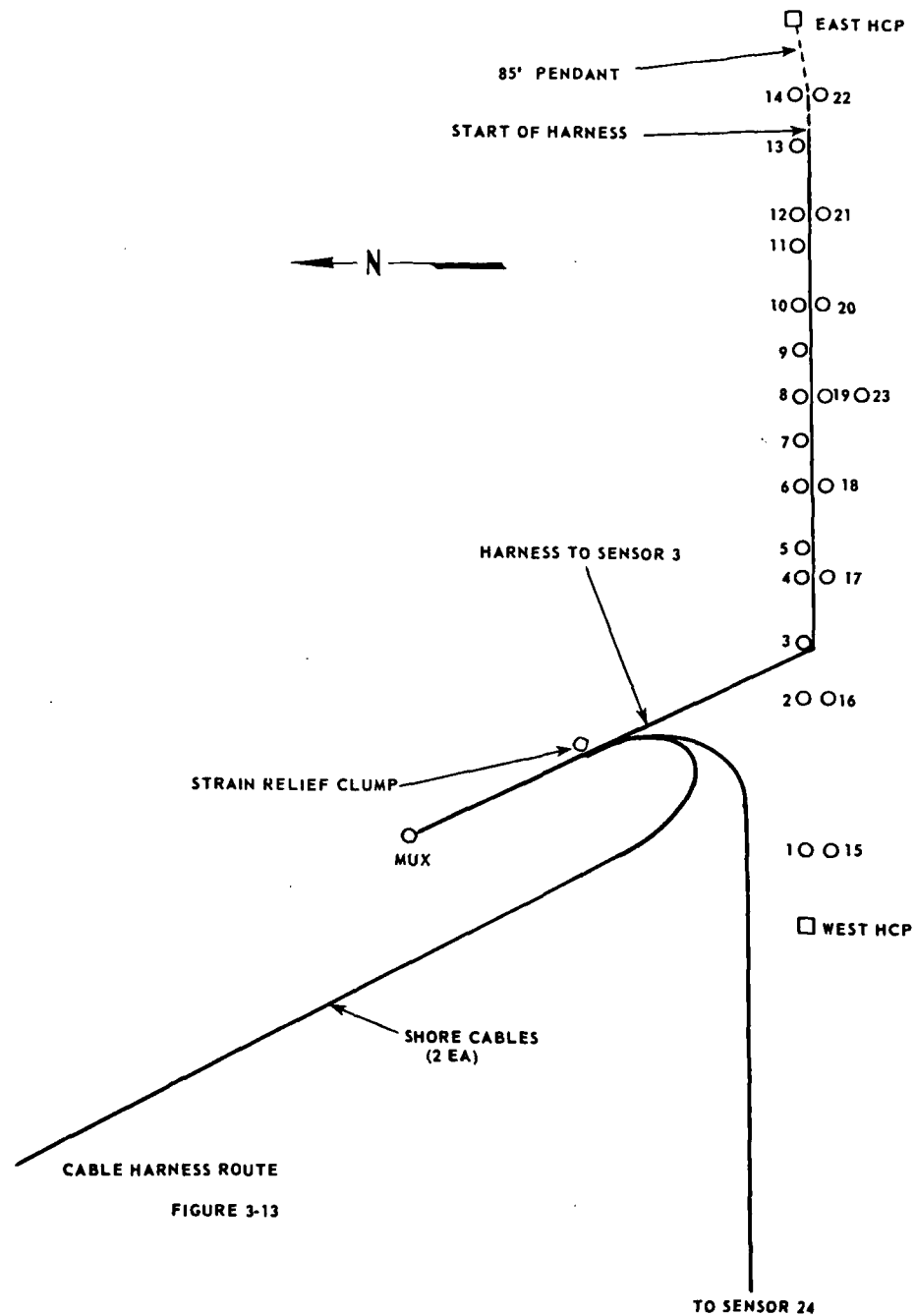
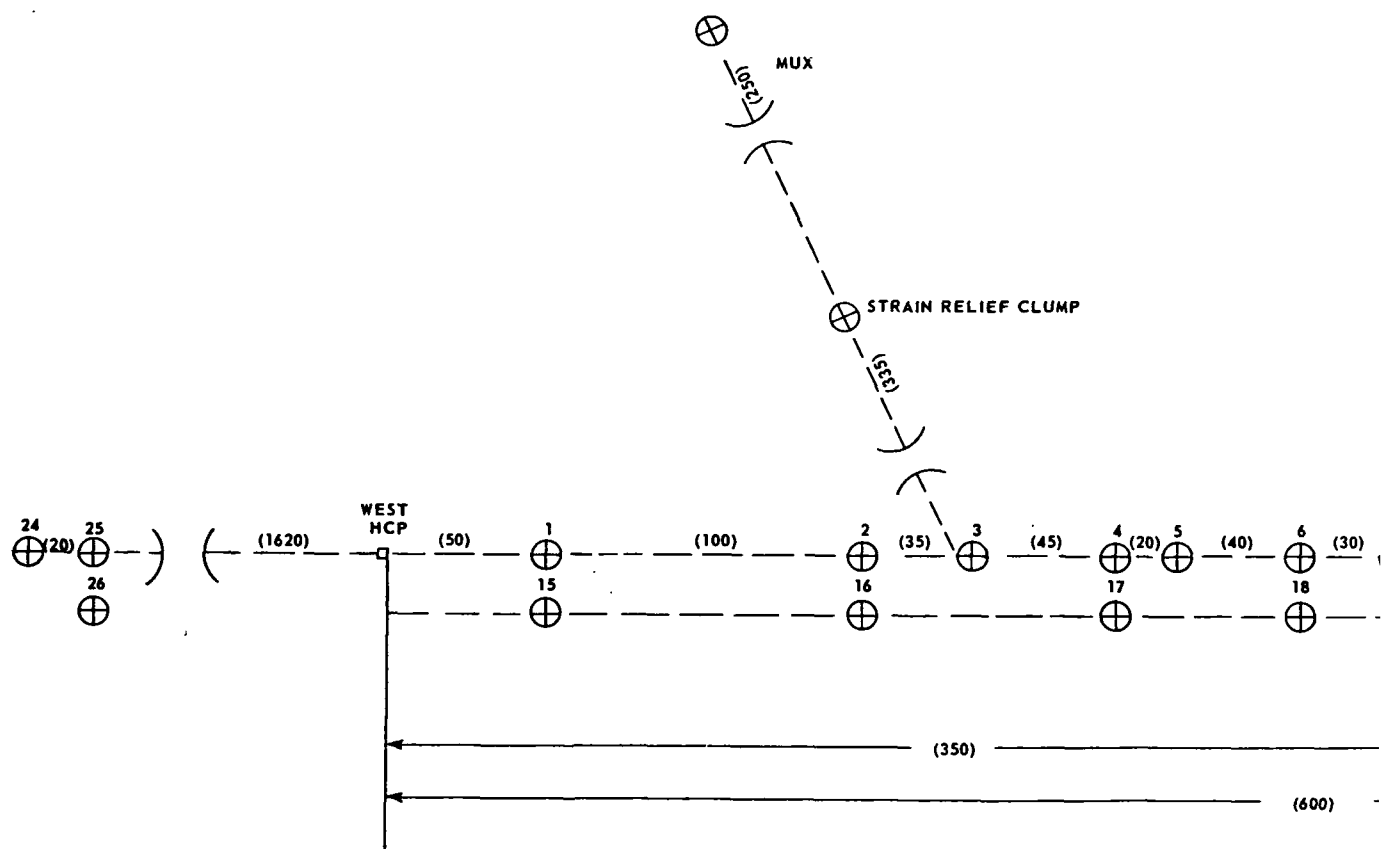
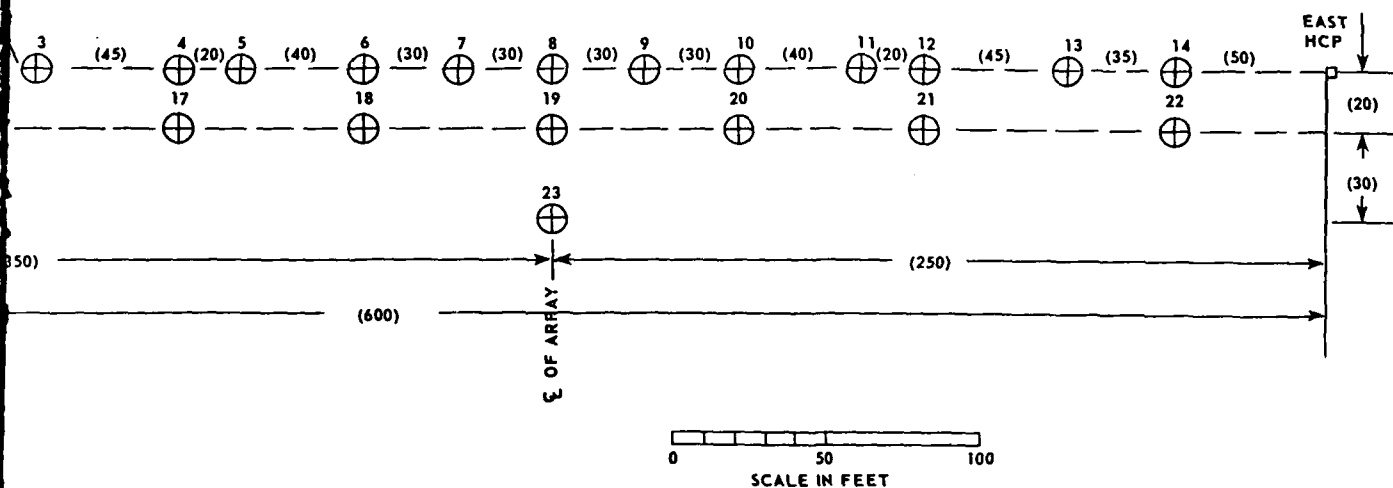


FIGURE 3-13



RELIEF CLUMP



ARRAY PLAN VIEW

FIGURE 3-14

Cable Interconnections Between Sensor Foundations

As stated previously, all of the sensors in the near field are connected to the main multiplexer unit by cables contained within a single cable harness. The Type C sensors, the Type B sensors, and the Type D sensor are cabled directly from this harness. For the Type A sensors, however, there is a Type A electronics unit housed within the corresponding Type B sensor foundation to which the cable from the harness is connected; a separate cable is then fed from this electronics unit to the corresponding Type A sensor.

The Type B sensor foundations in the intermediate field contain a multiplexer unit as well as the Type A electronics unit. The four shore cables serving the intermediate field lead directly into the Type B sensor foundations and connect to the multiplexer. Connections are made within the foundation from the multiplexer to the Type B sensor and to the electronics unit. From the latter a cable is led out of the foundation and north to the Type A sensor.

These interconnections are diagrammed in Figure 3-15 which attempts to show how both the near field and intermediate field Type A and Type B sensors are connected.

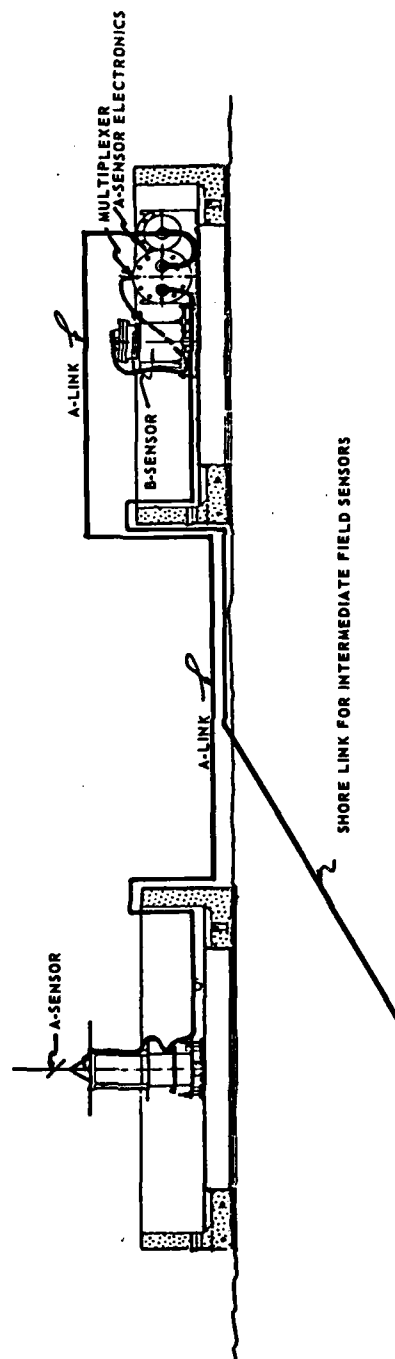
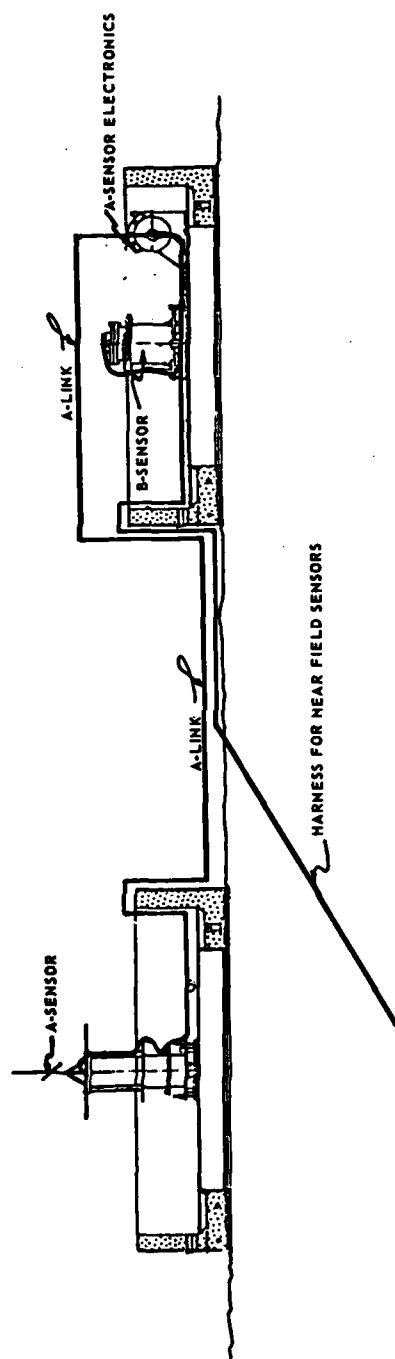
4.0 SENSOR MOUNTING CONFIGURATIONS

There are essentially six types of sensor and mounting combinations used in the Port Everglades Shallow Water Range. These are delineated below and illustrated in the designated figures which follow. The sketches at the bottom of each figure indicate where in the array the various types of sensors and mountings are located.

- Near Field A-Type Sensor and Mount ----- Figure 4-1
- Intermediate Field A-Type Sensor and Mount --- Figure 4-2
- Near Field B-Type Sensor and Mount ----- Figure 4-3
- Intermediate Field B-Type Sensor and Mount --- Figure 4-4
- Near Field C-Type Sensor and Mount ----- Figure 4-5
- Near Field D-Type Sensor and Mount ----- Figure 4-6

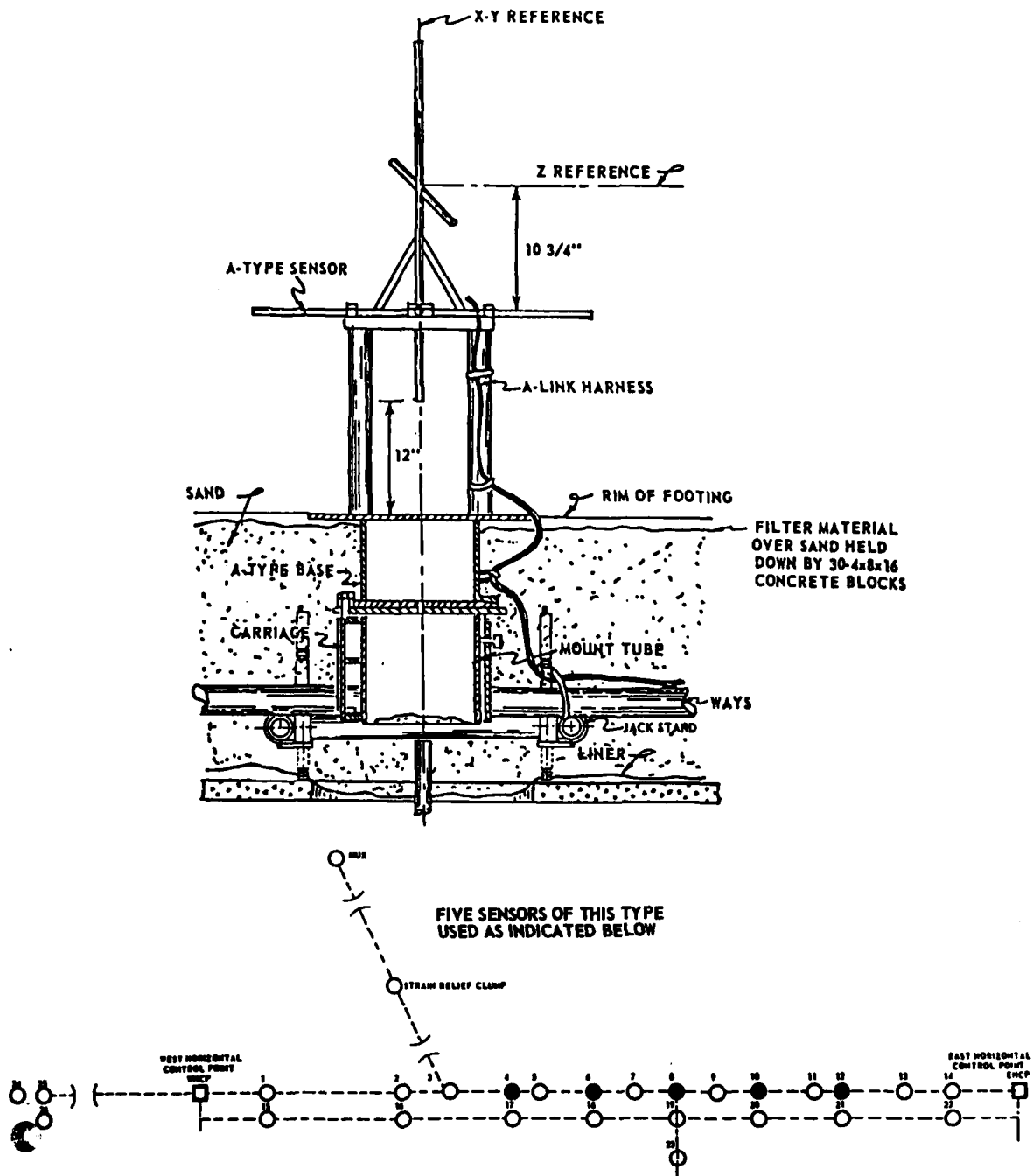
Foundations and Sensor Mount Frames

All 26 sensors are mounted within protective concrete foundations that were fabricated in accordance with Figure 4-7. It was initially intended that all sensors would be mounted within the foundations on a PVC pipe frame so arranged that the sensor could be leveled and adjusted north and south and



WIRING ARRANGEMENT FOR TYPE-A
AND TYPE-B SENSORS

FIGURE 3-15



NEAR FIELD A-TYPE SENSOR AND MOUNT

FIGURE 4-1

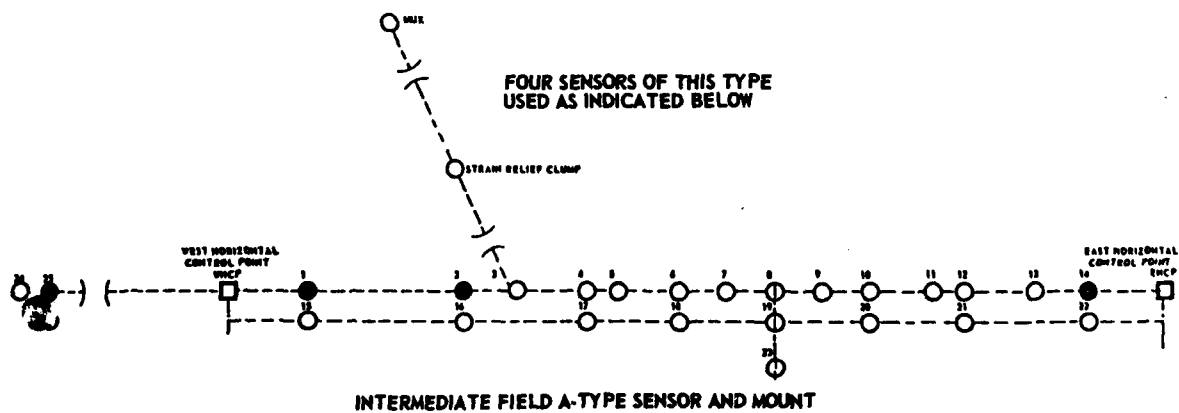
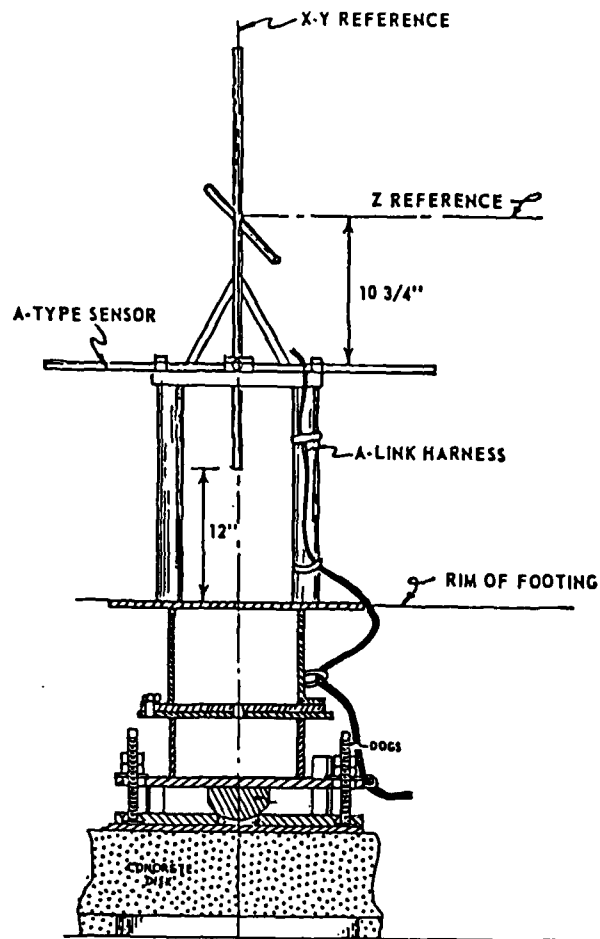


FIGURE 4-2

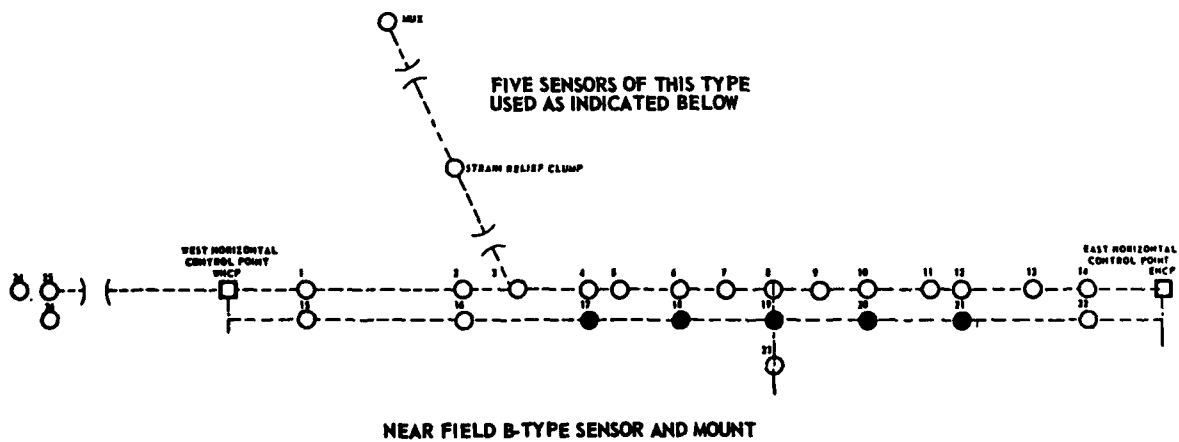
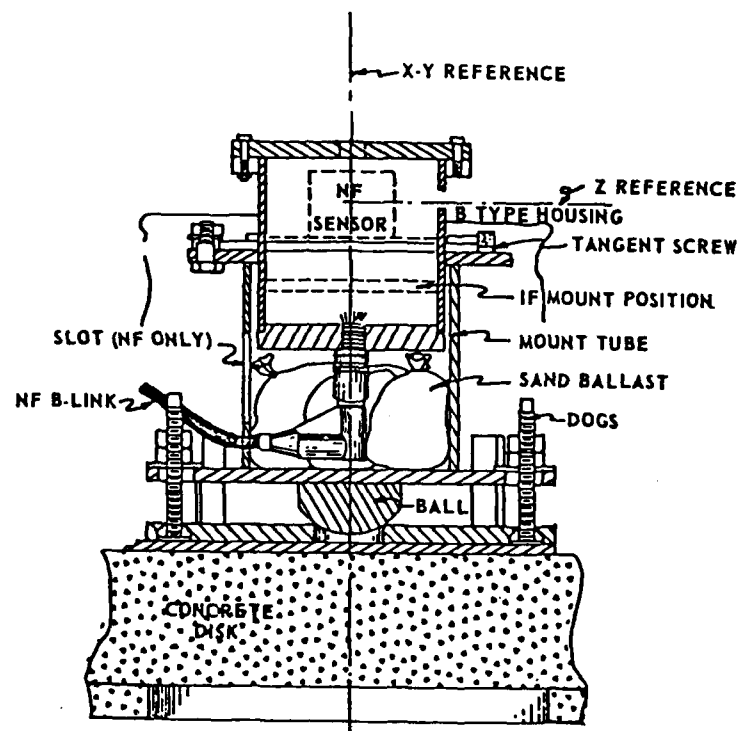
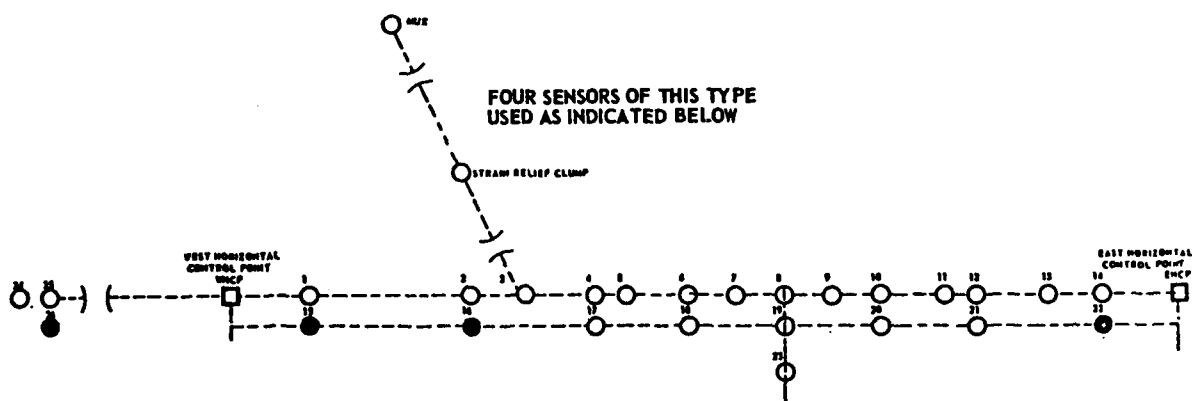
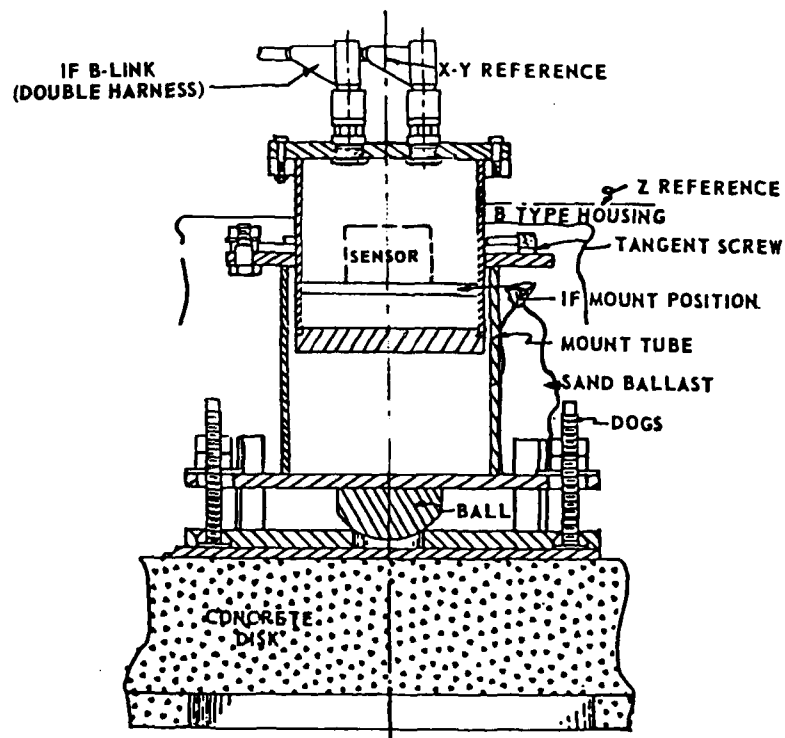


FIGURE 4-3



INTERMEDIATE FIELD B-TYPE SENSOR AND MOUNT

FIGURE 4-4

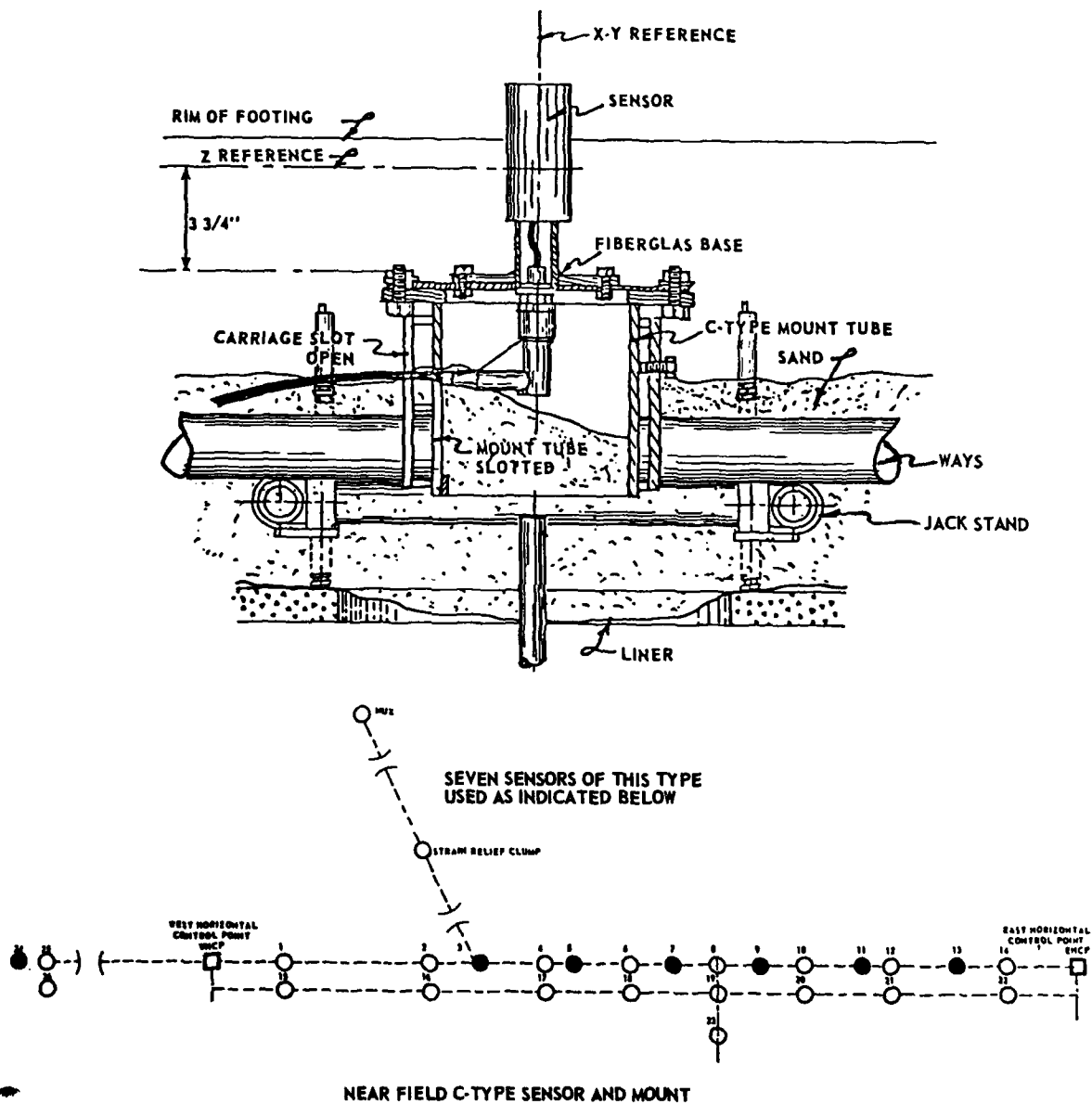
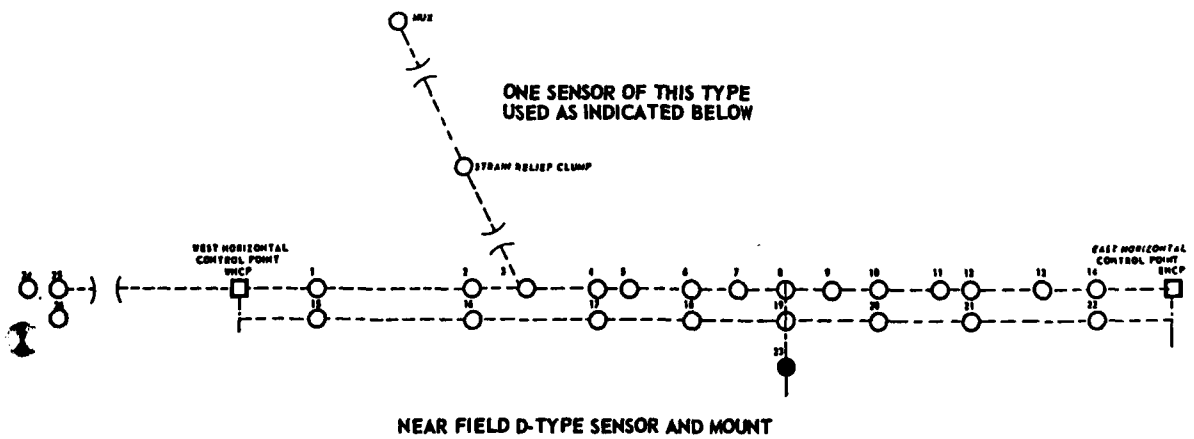
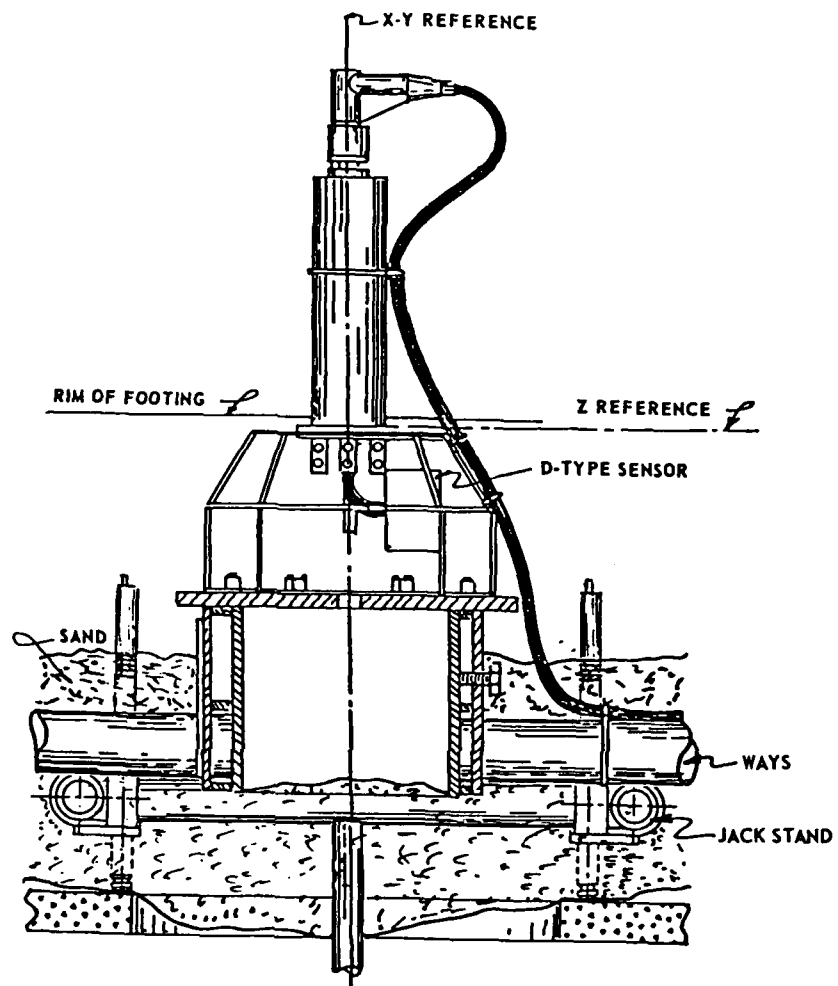


FIGURE 4-5



east and west until it was centered in the prescribed location. The general configuration of this adjustable pipe frame is shown in Figure 4-8 and a typical sensor installation is shown in Figure 4-9.

The overall design of the sensor mount frame described above is given in Figure 4-10 with details of the leveling screw in Figure 4-11, of the corner assembly in Figure 4-12, and the sensor mount carriage assembly in Figure 4-13.

Prior to the sensor installation, analysis and testing showed that a possible problem involving vibration existed. The pipe frame sensor mounts were designed to permit sensor adjustment in the horizontal plane to meet the precise positional specifications. These pipe frames did, however, sacrifice rigidity somewhat to fulfill the x, y adjustment requirements. At this point in time, it was decided that the possible vibration problem needed resolution and the optional method was to provide a new inherently rigid mount. The pipe frames were utilized as templates to provide positional control for the new rigid mounts. These new rigid mounts were used on all B type sensors and for the four intermediate field A type sensors.

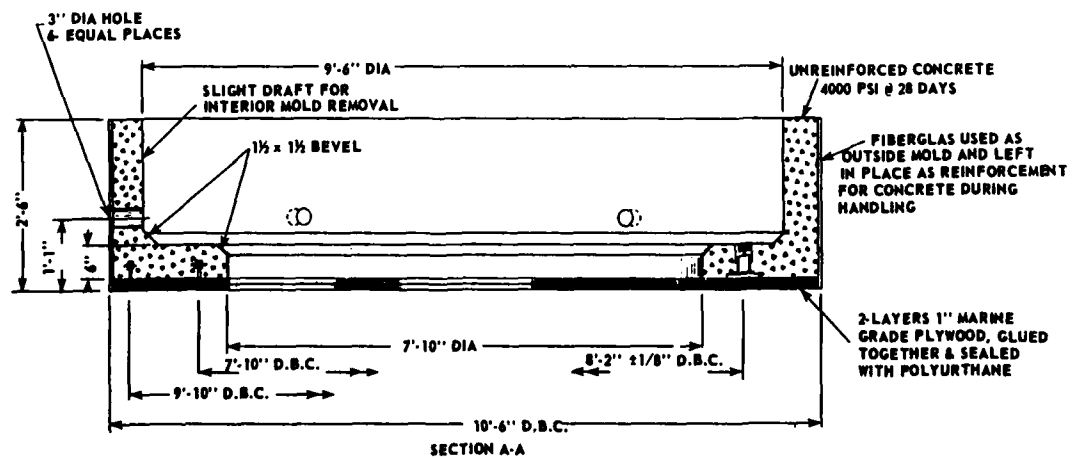
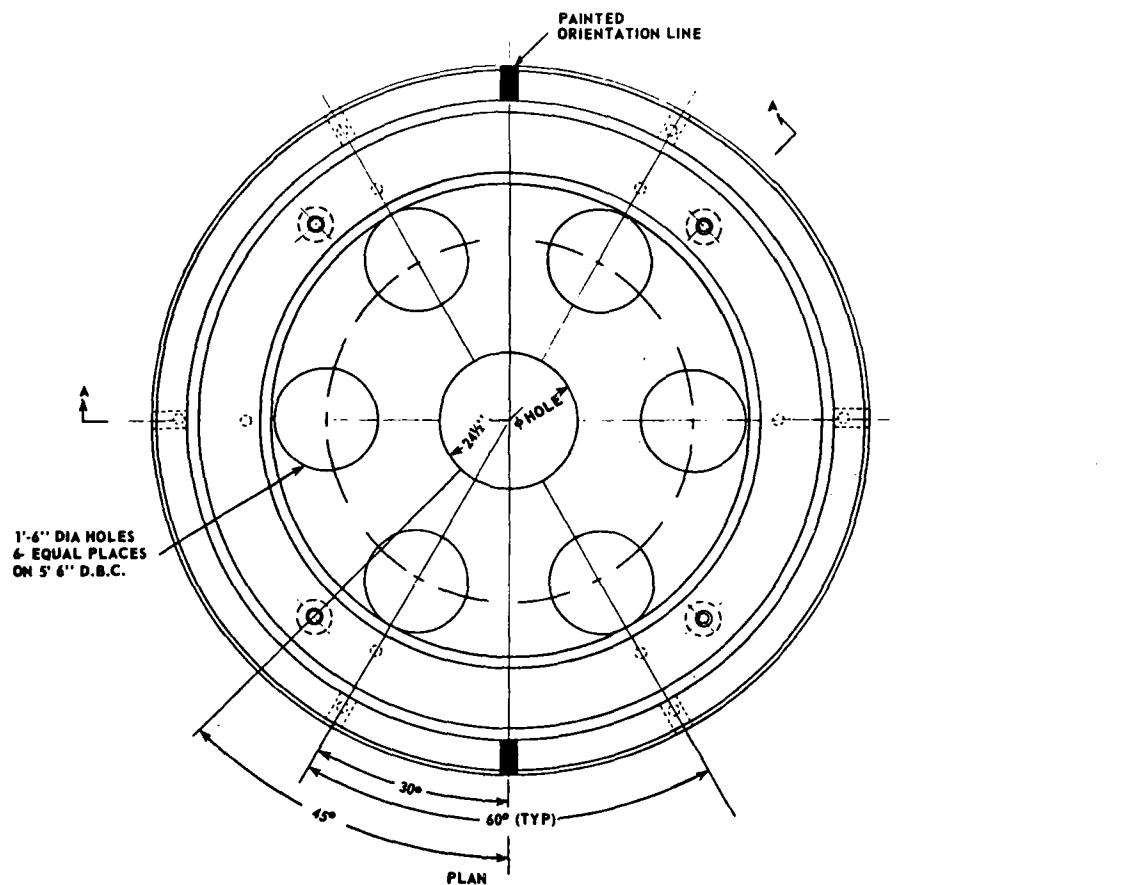
Jack Assemblies for Steadying Sensors

For the near field A-type, C-type, and D-type sensors, where the mount frames had already been installed, the stabilizing solution was to install a jack assembly below the mount frame which could be used to support the sensor in closer proximity to the vertical centerline of the assembly. The jack assemblies, as shown in Figure 4-14, were similar to the mount frame except that the span was reduced from 78 inches to 31 inches; corner details were the same as for the mount frames, Figure 4-12. These jack stands were used for the near field A-type sensors, C-type sensors, and the D-type sensor. Sand fill was still required for additional stabilization of these sensors.

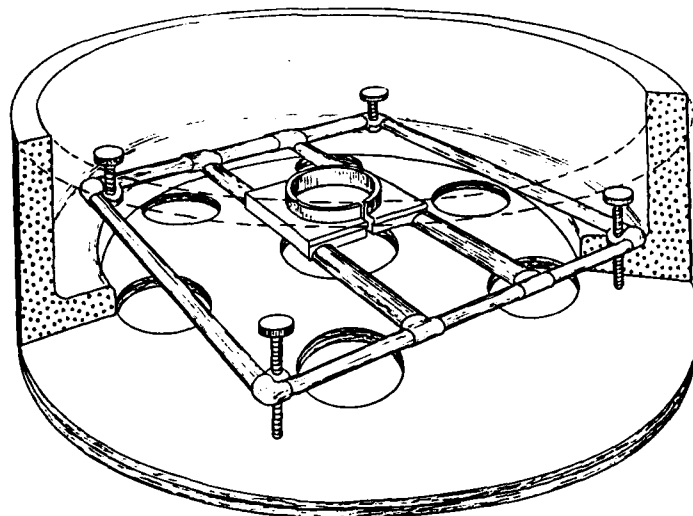
Concrete Disc and Ball-Joint Sensor Supports

For the remaining 13 sensors, comprising 4 intermediate field A-types, 5 near field B-types, and 4 intermediate field B-types, a different stabilizing system was devised. The basic stabilizing assembly is illustrated in Figures 4-2, 4-3, and 4-4.

The base consisted of a concrete cylinder about 93 inches in diameter and 6 inches deep. Atop this cylinder was glued a 2' x 4' PVC mounting plate and hold-down bolts for the other units were set into the concrete disc as required.

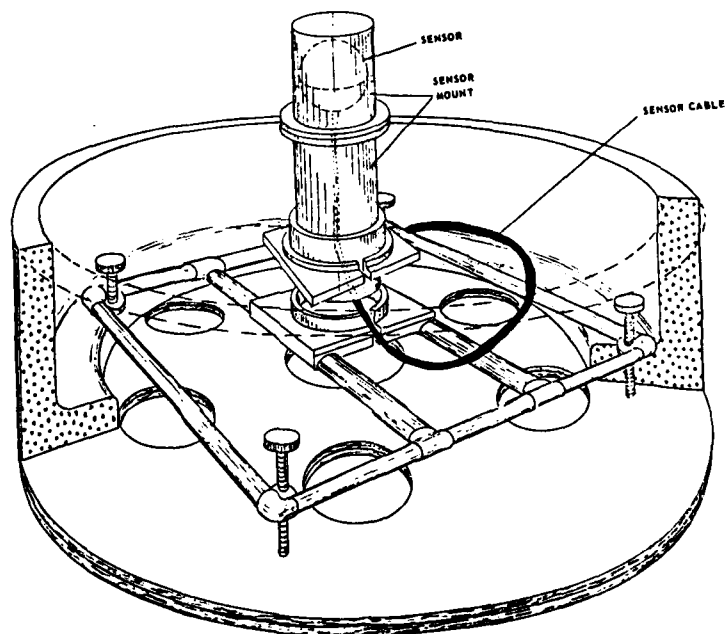


SENSOR FOUNDATION CONSTRUCTION DETAILS



BASIC SENSOR FOUNDATION WITH LEVELING PIPE FRAME

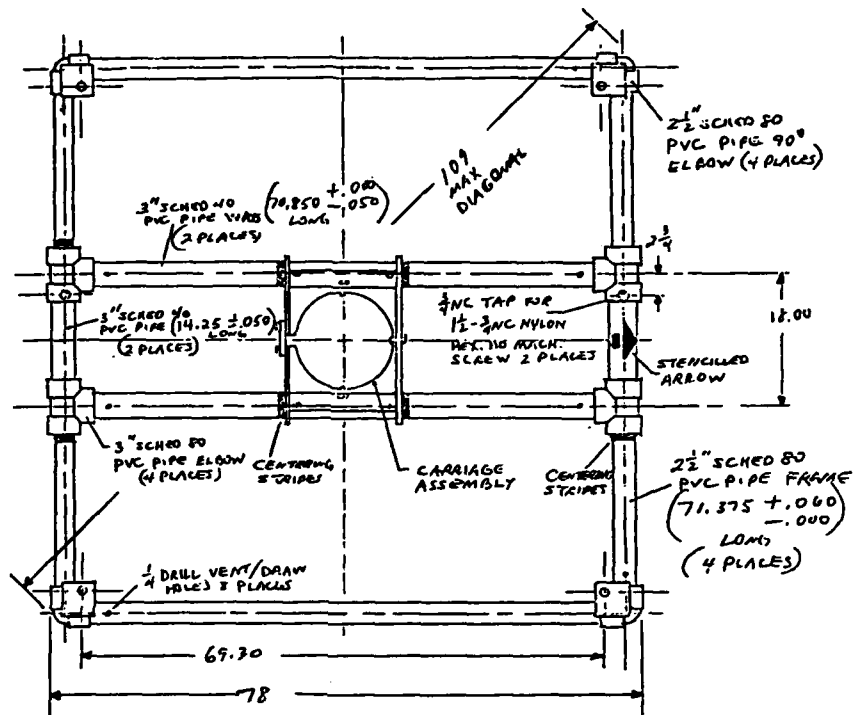
FIGURE 4-8



TYPICAL SENSOR BEING MOUNTED ON PIPE FRAME

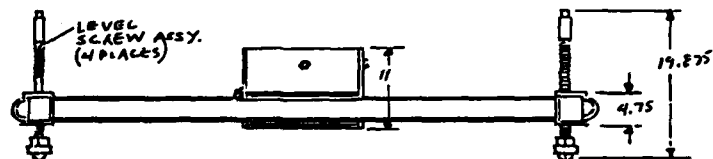
FIGURE 4-9

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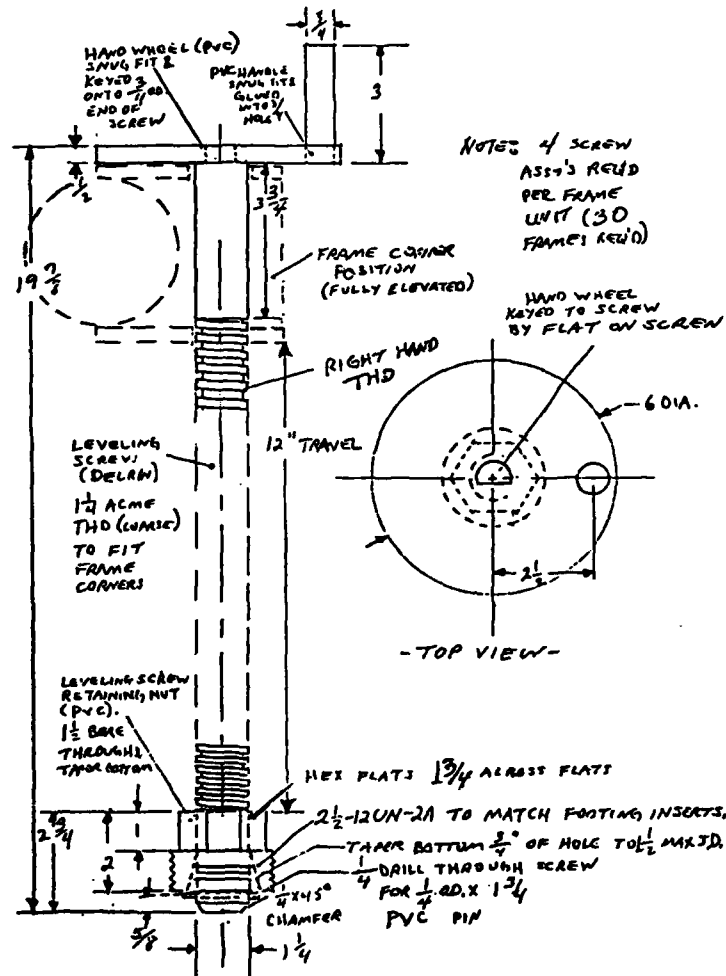
NOTE: USED
FOR NFA, C
& D SENSORS

1. WELDED PVC CONST.



SENSOR MOUNT FRAME

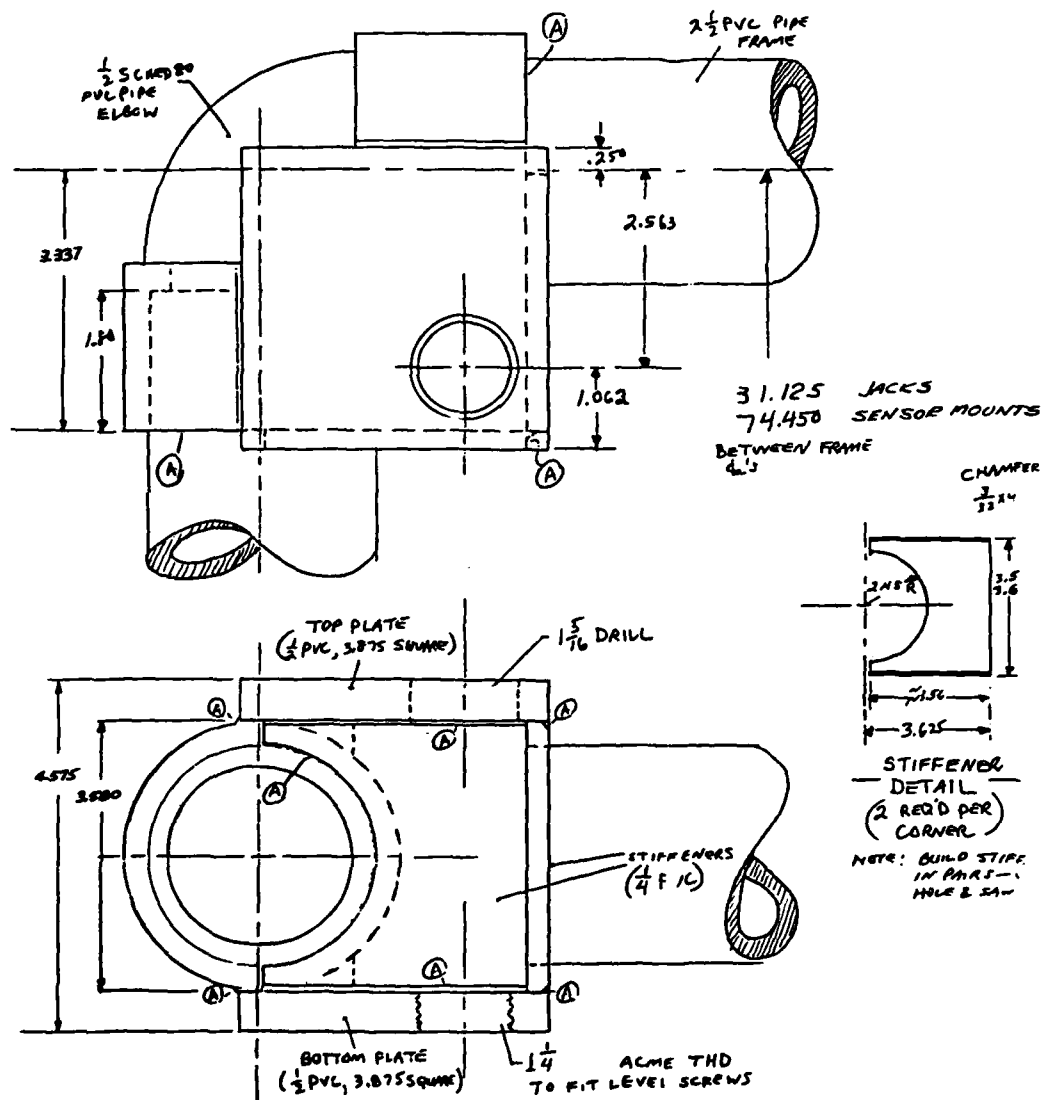
FIGURE 4-10



LEVELING SCREW FOR SENSOR MOUNT FRAME

FIGURE 4-11

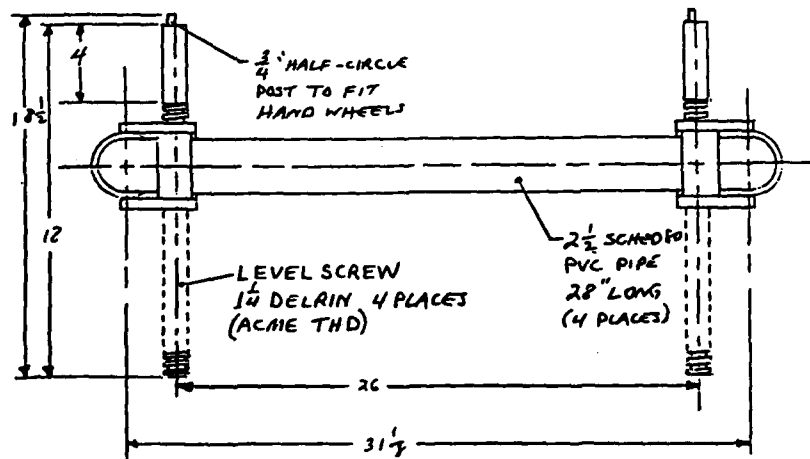
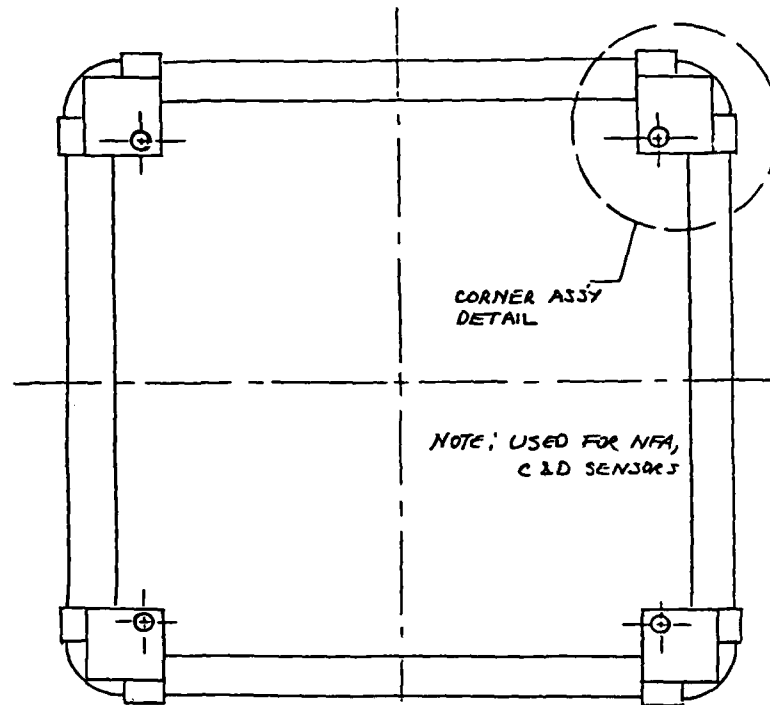
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CORNER ASSEMBLY FOR SENSOR MOUNT
FRAMES AND FOR JACK FRAMES

FIGURE 4-12

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JACK ASSEMBLY

After transfer of alignment information from installed pipe frames, a leveling assembly base plate, Figure 4-15, was cemented to the mounting plate; this base plate had four vertical guide bars cemented in place and, equally spaced between the guide bars, were four rounded holes for retaining swiveling dogs, Figure 4-16. These dogs and swivel balls are detailed in Figure 4-17.

The entire weight of the sensor was supported on a leveling assembly ball that was welded to the leveling assembly bottom flange, Figure 4-18, and pivoted in a 4.25 inch diameter hole in the leveling assembly base plate. The dogs were threaded rods which passed through oversized holes in the leveling assembly bottom flange. Nuts were provided on the dogs to secure the bottom flange and to force the leveling assembly ball down into the hole in the leveling assembly base plate. Leveling was accomplished by alternate tightening and loosening of the dog nuts. Bags of sand ballast were placed atop the leveling assembly bottom flange to make the sensor assembly negative in water.

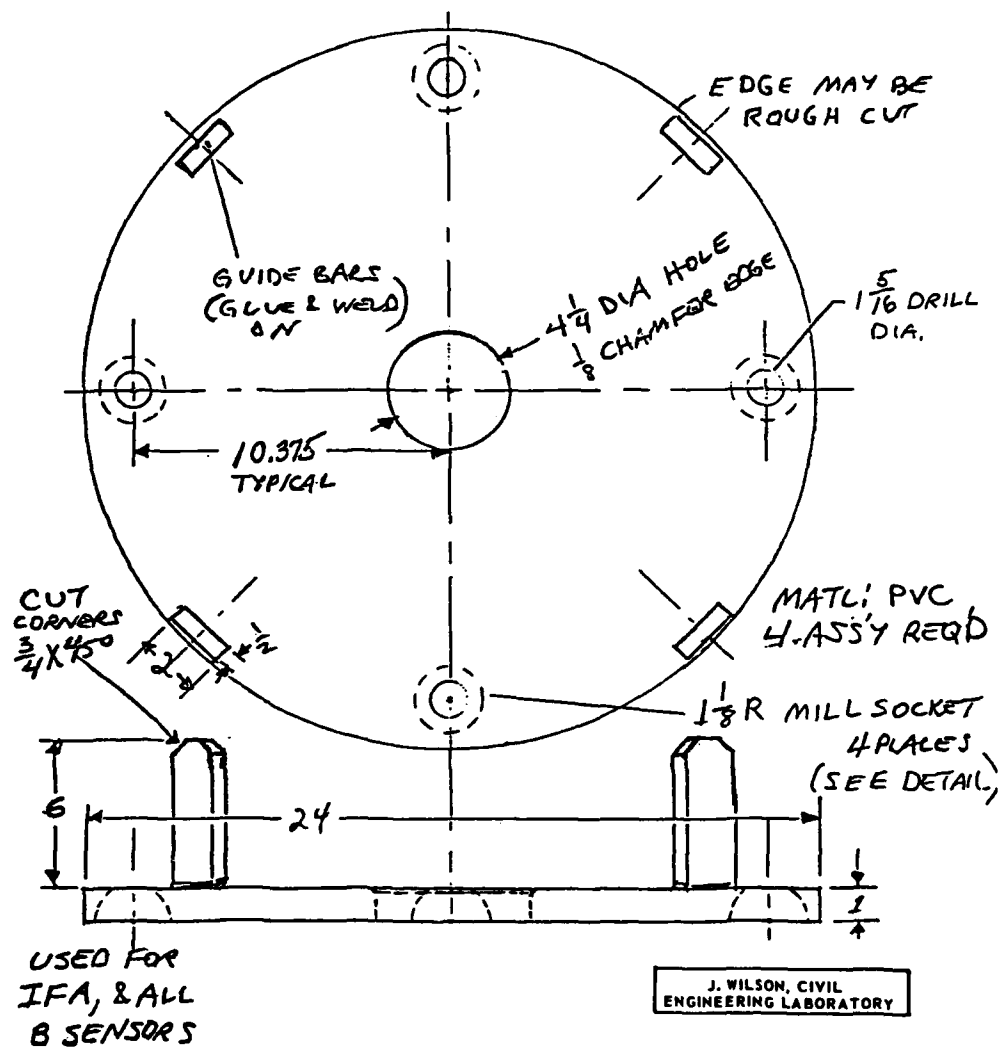
5.0 SENSOR AND ELECTRONICS PRESSURE VESSELS

A-Type Sensor Mounts and Base Assemblies

Assembly drawings of the near field and intermediate field sensors are shown in Figures 4-1 and 4-2. The sensor base assembly is held in place atop a mount tube by means of three bolts and spacers and a tangent screw assembly is provided to train the pressure vessel in azimuth relative to the mount tube.

The mount tube comprises a short length of 12-inch, Schedule 40, PVC pipe atop which is welded a 19-inch diameter 3/4-inch thick flange with 12 bolt holes drilled around the perimeter. As shown in Figure 5-1, there are two different mount tube lengths provided -- one for the near field sensors that are secured to the pipe frame carriages and one for the intermediate field sensors that are fitted on the leveling assembly bottom flange.

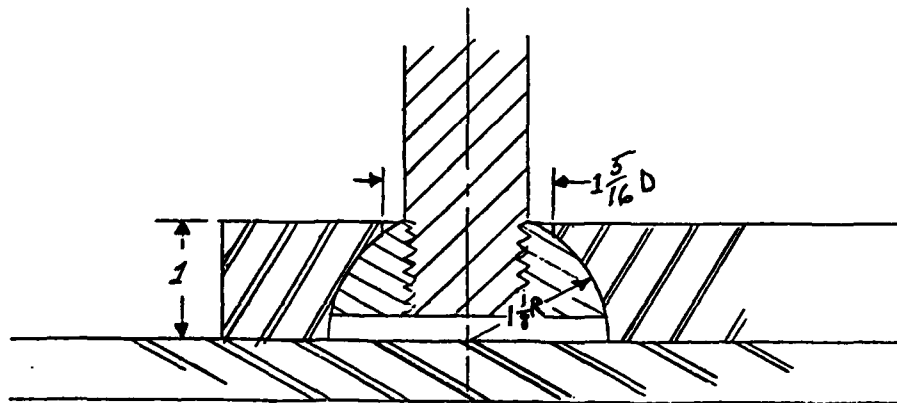
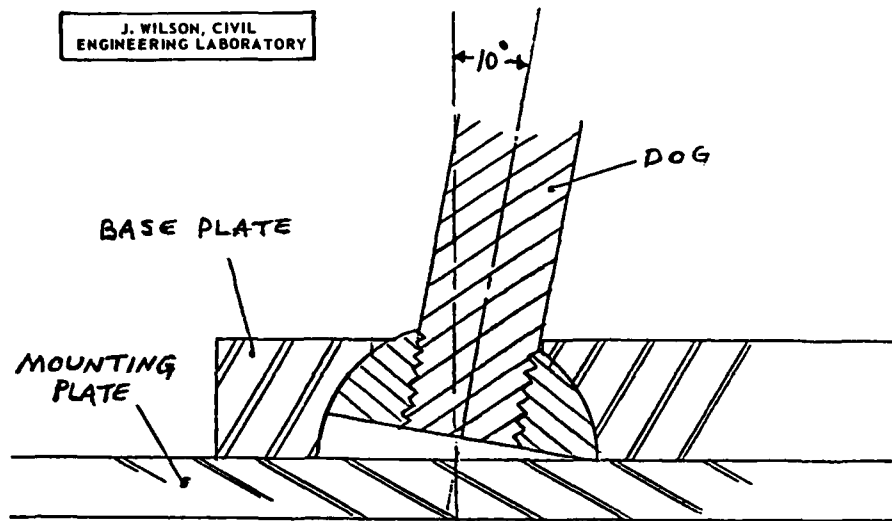
The base assembly for each A-type sensor is a 12-inch PVC pipe with a 28-inch diameter, 1/2-inch thick sensor base plate welded on top and a 15.25-inch diameter mounting ring welded on the bottom. As shown in Figures 5-2 and 5-3, a gear segment is attached to the mounting ring and a tangent screw is attached to the top of the mount tube flange so that the sensor base assembly can be rotated with respect to the foundation. When the correct azimuth has been attained the retaining screws can be secured to fix the sensor in place.



LEVELING ASSEMBLY BASE PLATE

FIGURE 4-15

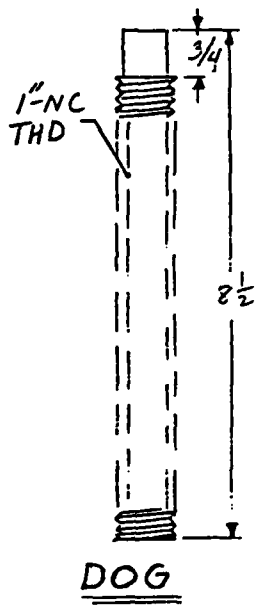
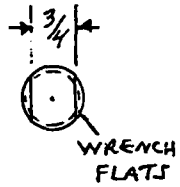
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DOG SWIVEL DETAIL

FIGURE 4-16

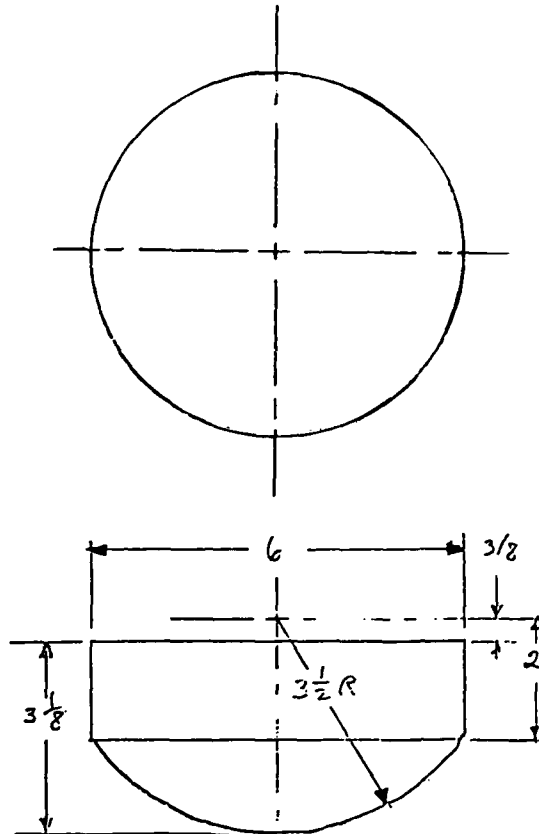
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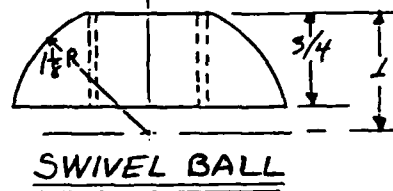
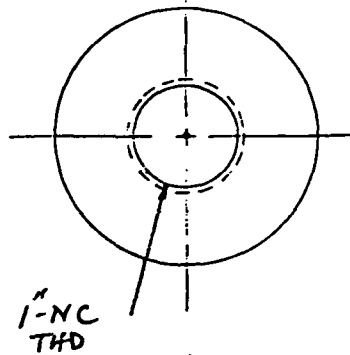
MATL: PVC

LEVELING ASSEMBLY BALL,
SWIVEL BALL, AND DOG

FIGURE 4-17

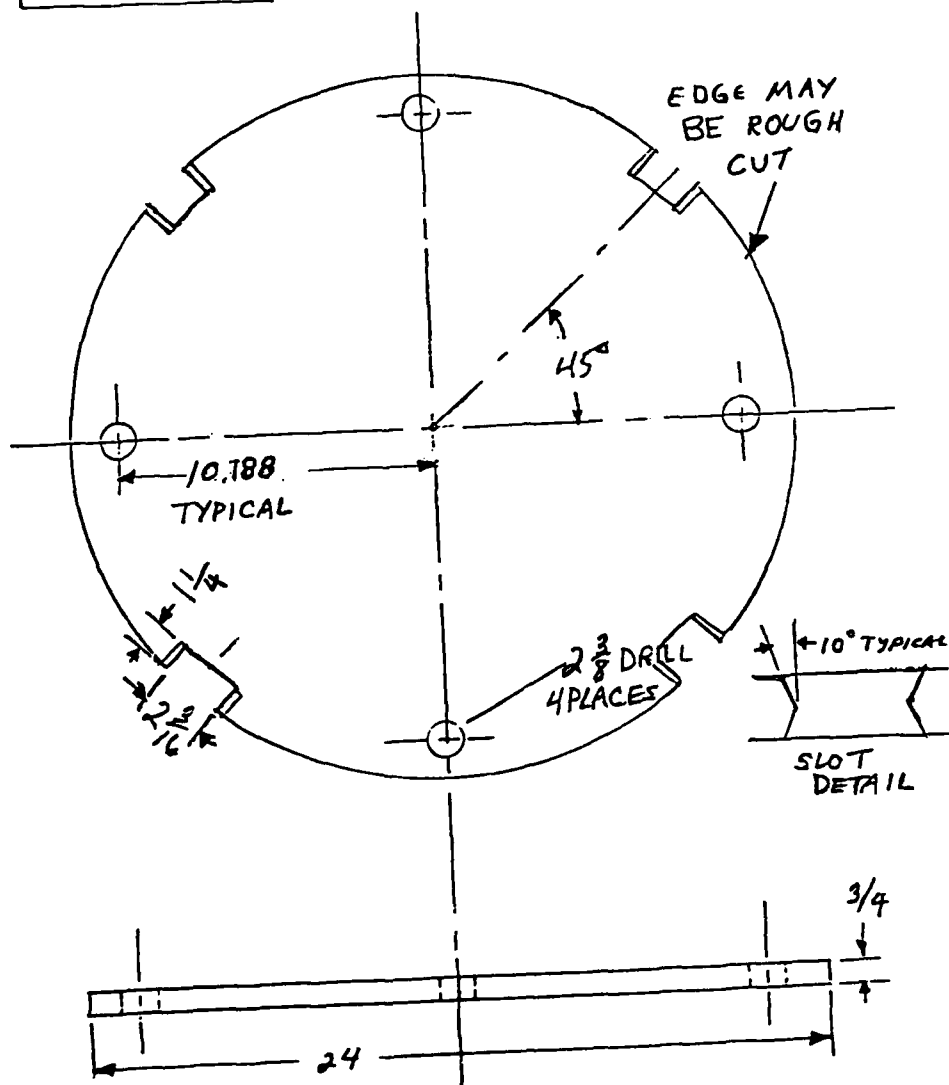


LEVELING ASSEMBLY BALL



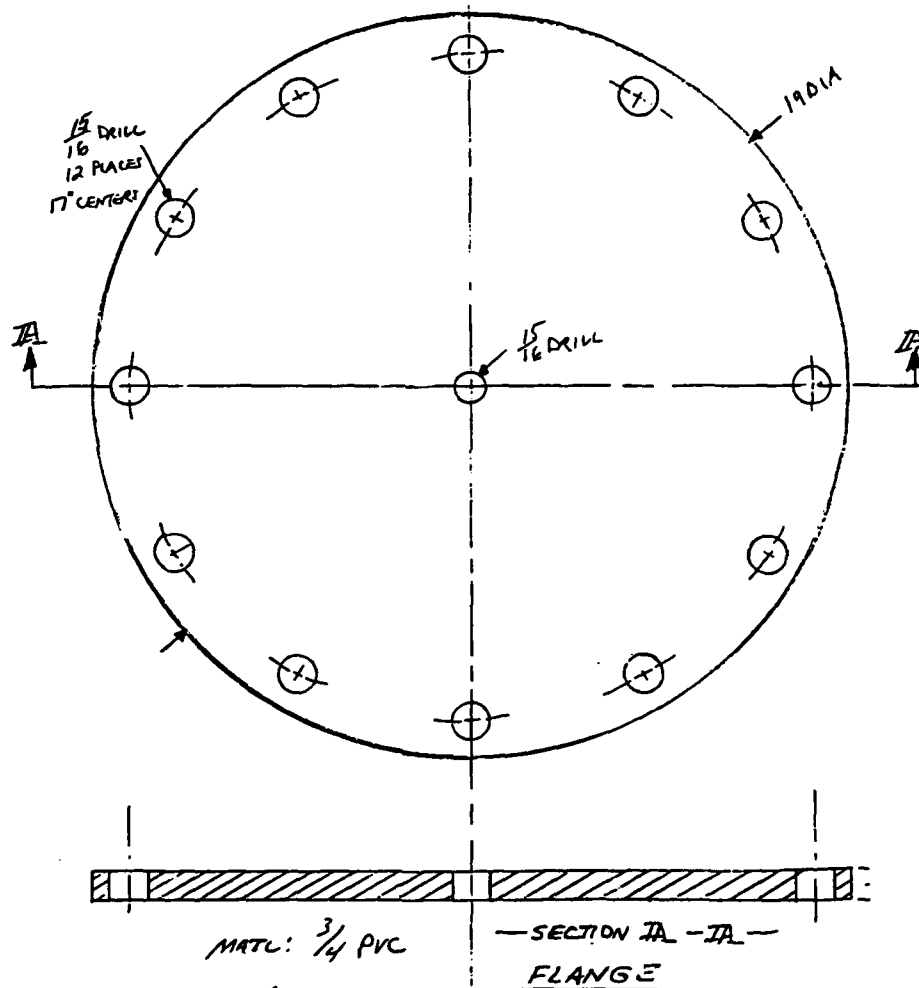
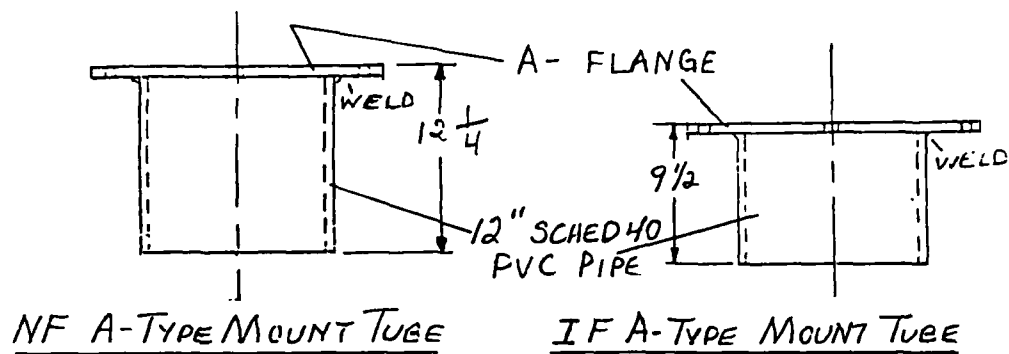
SWIVEL BALL

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LEVELING ASSEMBLY BOTTOM FLANGE

FIGURE 4-18



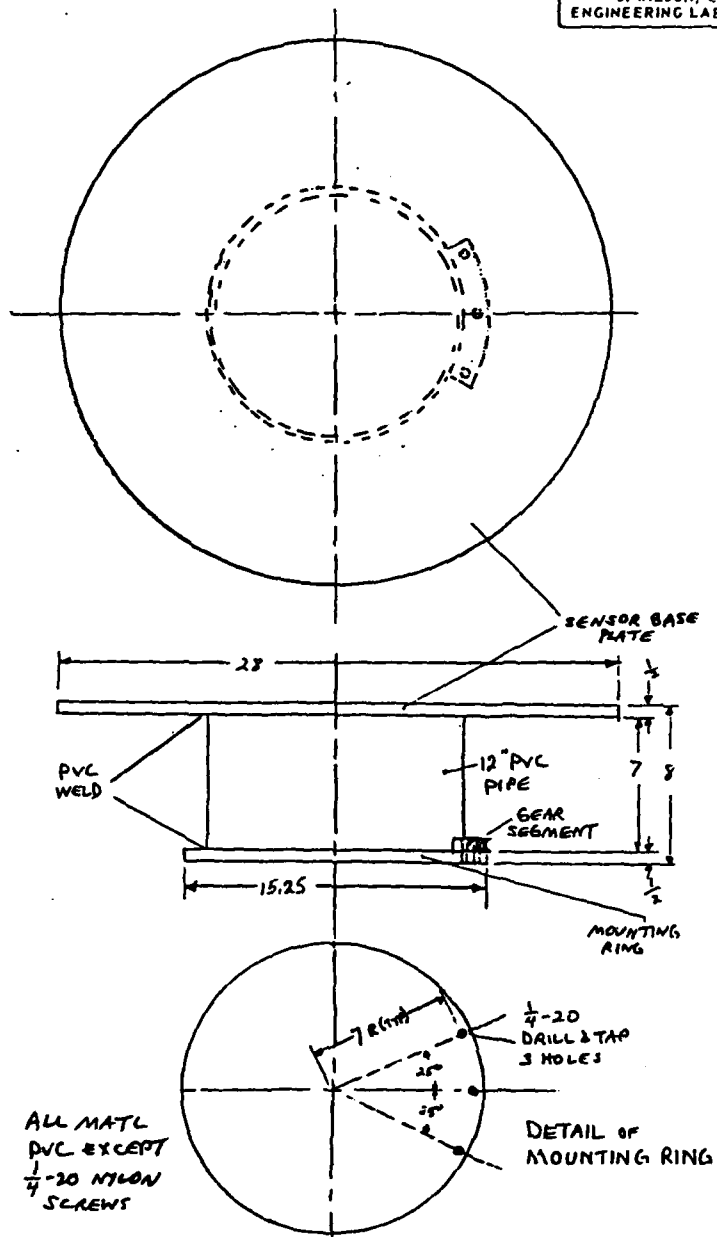
• USED FOR ALL A-TYPE SENSORS •

10 REQ'D

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NEAR FIELD AND INTERMEDIATE FIELD
A-TYPE SENSOR MOUNTING TUBES AND FLANGES

FIGURE 5-1



NEAR FIELD AND INTERMEDIATE FIELD A-TYPE SENSOR BASE ASSEMBLY

FIGURE 5-2

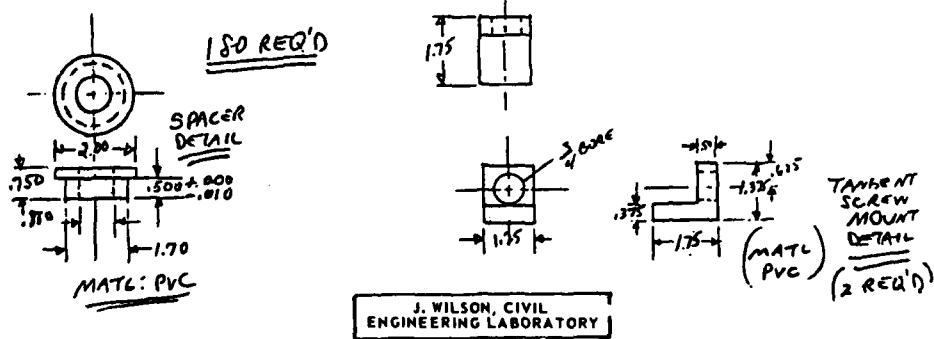


FIGURE 5-3

The housing top plates for the near field and intermediate field A-type sensors are as shown in Figure 5-4.

B-Type Sensor Mounts and Pressure Vessels

Assembly drawings of the B-type sensors and mounts are shown in Figures 4-3 and 4-4. The near field and intermediate field B-type sensor mount tubes are both made of 12-inch Schedule 40 PVC pipe, of equal length, atop which is welded a 19-inch diameter, 3/4-inch thick mounting tube flange as shown in Figure 5-5. However, the near field mount tube is slotted to provide a side opening for the B-link cable. The tangent screw shown in Figure 5-3 is attached to the mounting tube flange for both B-type sensor azimuth adjustments with the gears being secured to mounting rings that surround the housings. The exterior and interior mounting rings for the two B-type sensor mounts are identical as shown in Figure 5-6. However, the vertical location of both the interior and exterior mounting rings differ in the two B-type housings as shown in the upper and lower sketches of Figure 5-8. Additionally, the top plate for the intermediate field B-type sensor has two connector penetrations as shown in Figure 5-7 whereas the near field housing has none.

A-Type Sensor Electronics Housing (AELEX Housing)

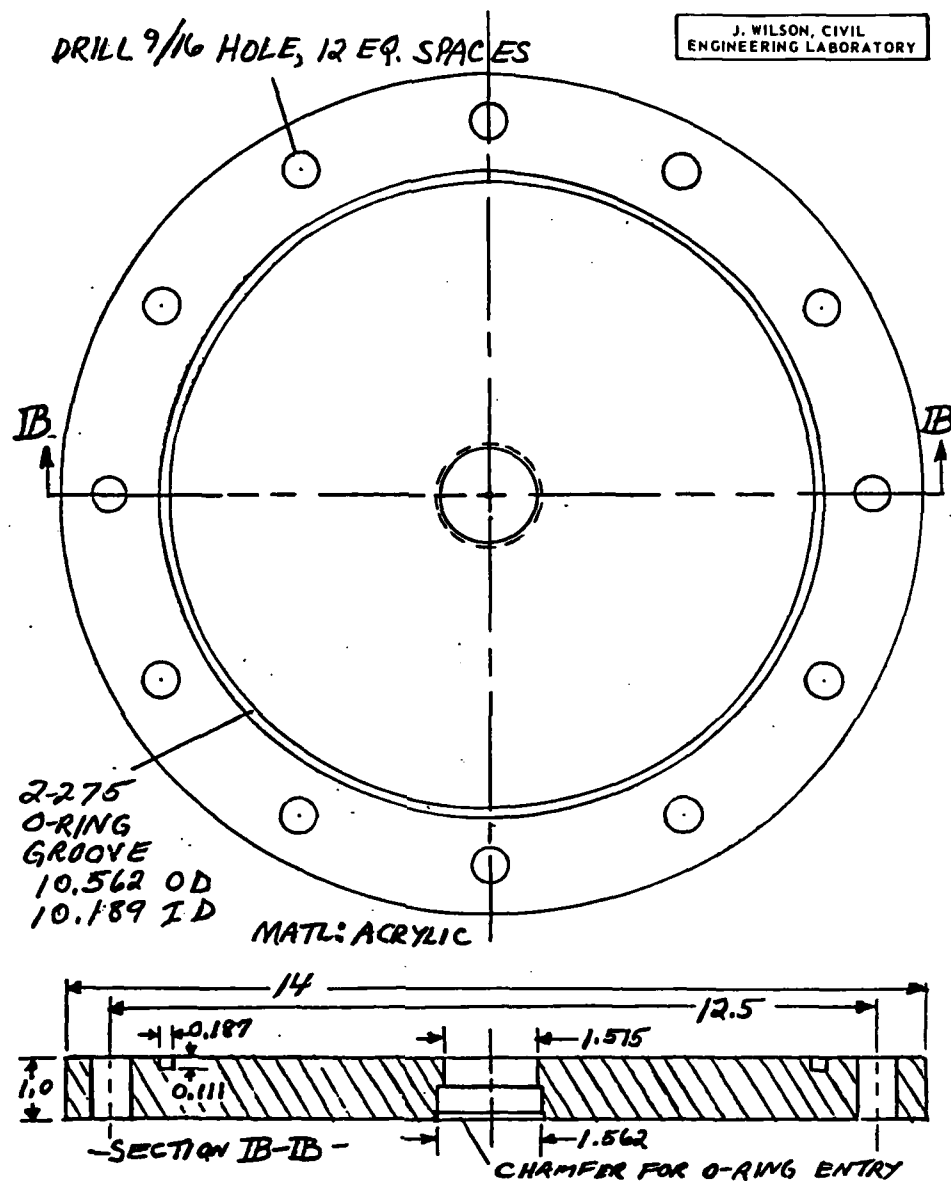
As stated earlier, the electronics for the A-type sensors are installed in the foundations of the corresponding B-type sensors. These AELEX housings are almost identical to the B-type sensor housings as shown in Figure 5-9 and the same internal and external mounting rings are used. The near field AELEX housing is the same as the intermediate field AELEX except that in the latter a housing extender, Figure 5-10, is inserted in the bottom plate.

C- and D-Type Sensor Mounting Units

The assembly for the C-type sensor is shown in Figure 4-5 and for the D-type sensor in Figure 4-6. In both cases the sensor is mounted directly atop the mounting tube flange with no housing required. The mounting tubes for these two sensors are shown in Figure 5-11.

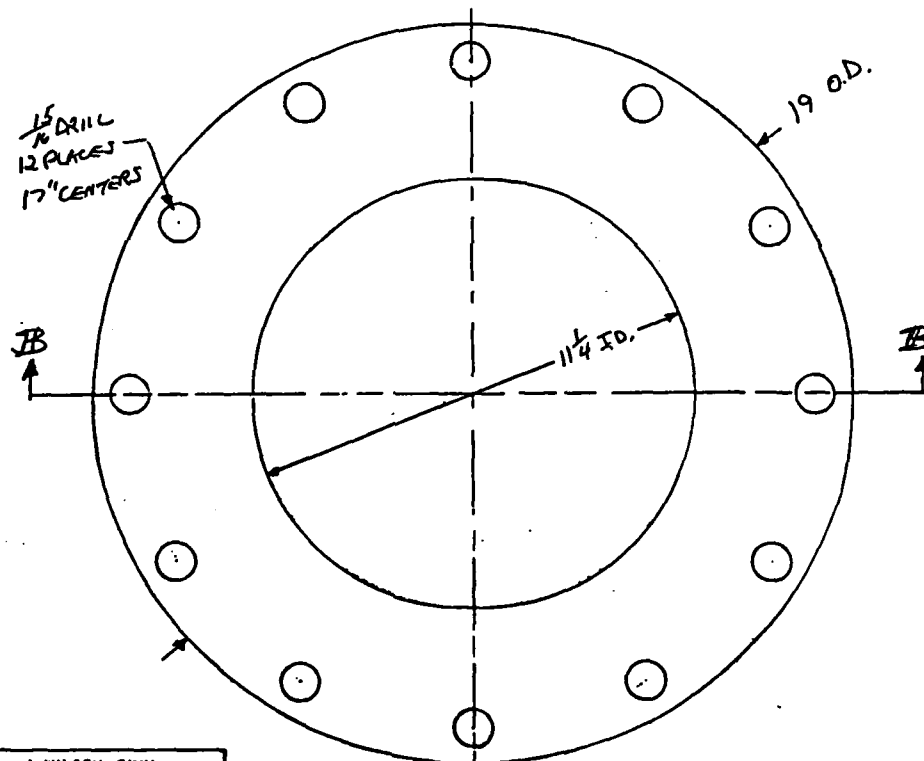
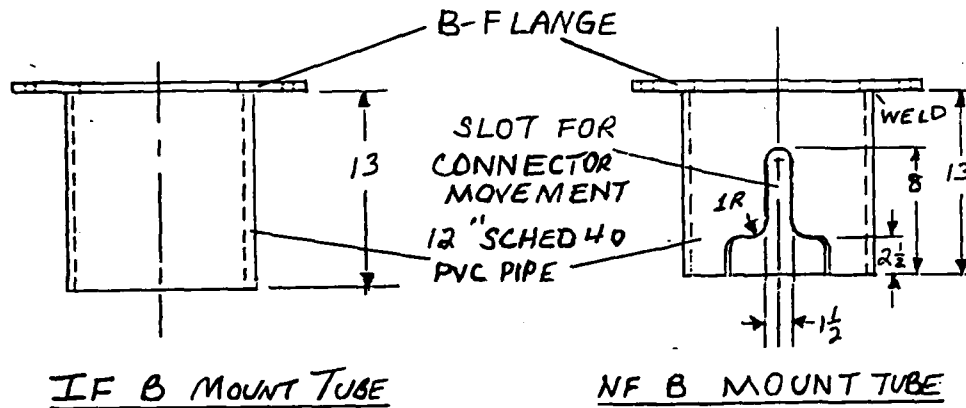
Near Field B-Type Sensor and A-Type Electronics Assembly

For the near field units the B-type sensors and the AELEX units are mounted on the same concrete disc as shown in Figure 5-12. The AELEX mounting bracket for this assembly is shown in Figure 5-13.

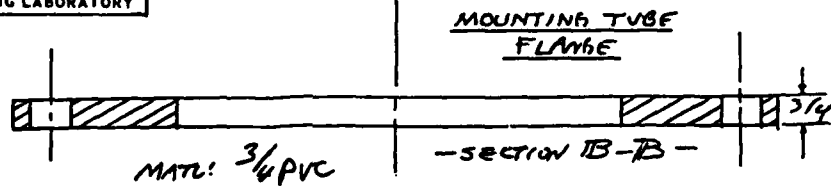


NEAR FIELD AND INTERMEDIATE FIELD
A-TYPE SENSOR ELECTRONICS HOUSING TOP PLATE

FIGURE 5-4



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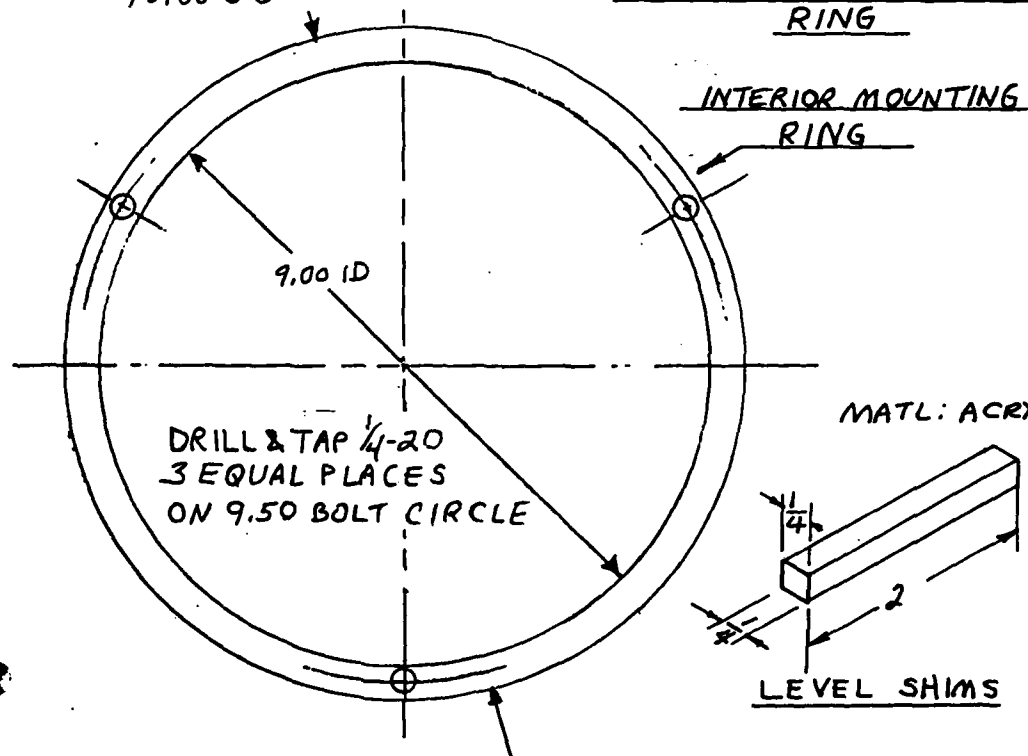
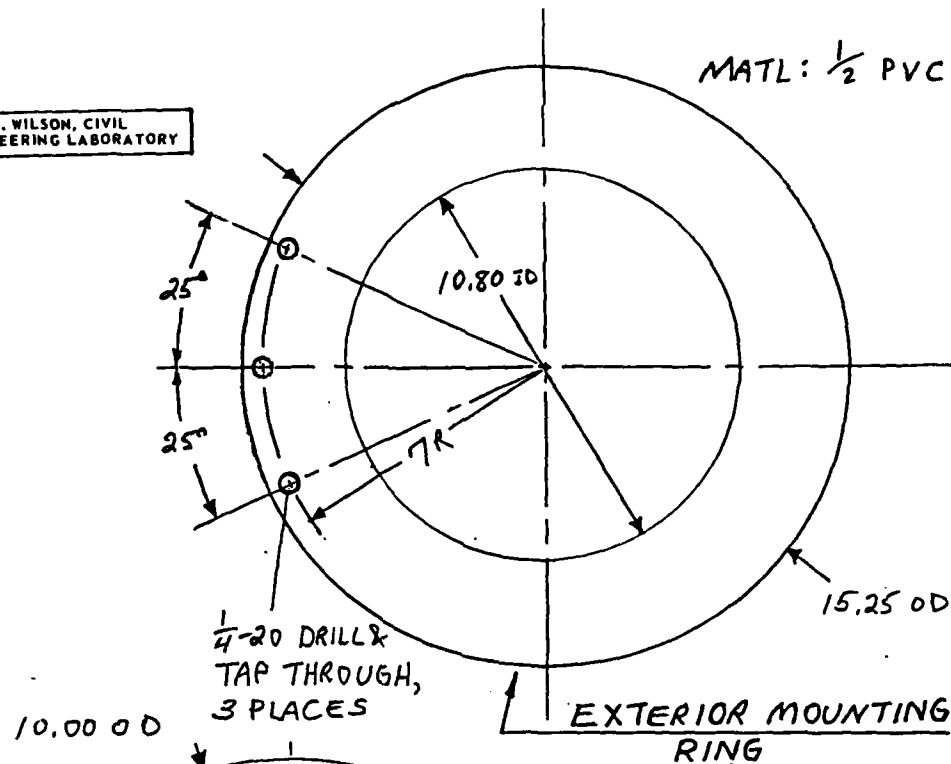


NEAR FIELD AND INTERMEDIATE FIELD
B-TYPE SENSOR MOUNTING TUBES AND FLANGES

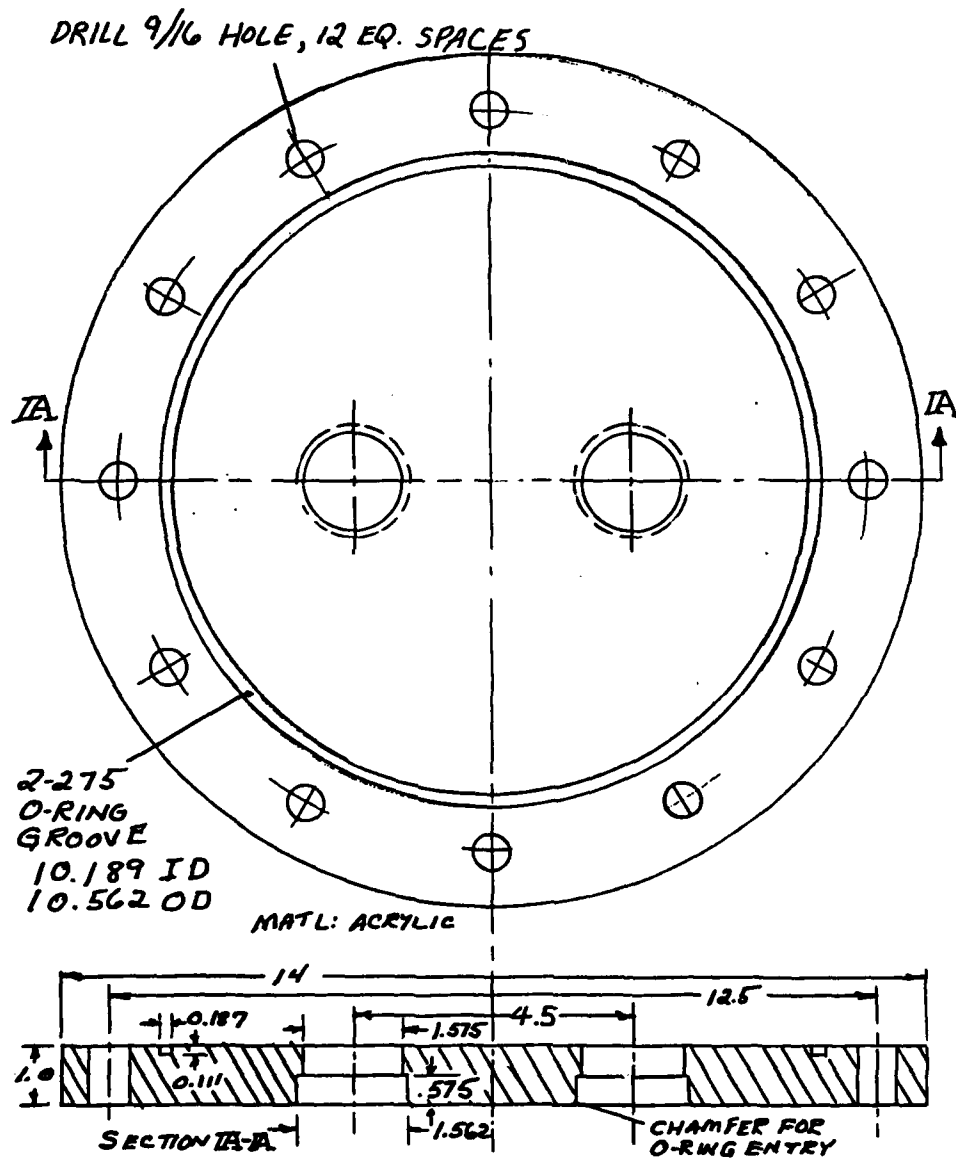
FIGURE 5-5

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MATL: $\frac{1}{2}$ PVC



NEAR FIELD AND INTERMEDIATE FIELD B-TYPE SENSOR HOUSING AND NEAR FIELD
A-TYPE SENSOR ELECTRONICS HOUSING MOUNTING RINGS AND SHIM DETAILS



INTERMEDIATE FIELD B-TYPE SENSOR HOUSING TOP-PLATE DETAILS

FIGURE 5-7

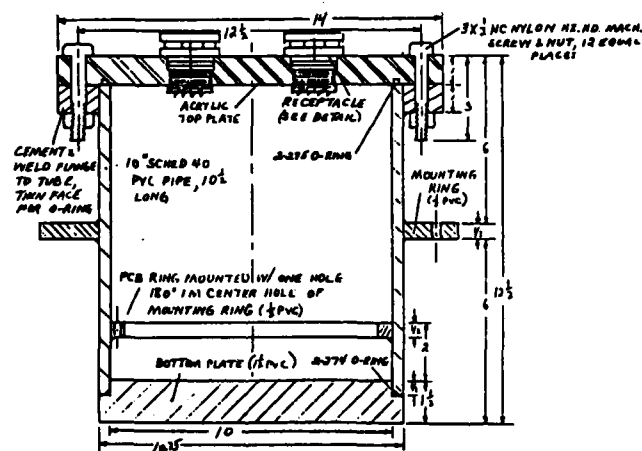
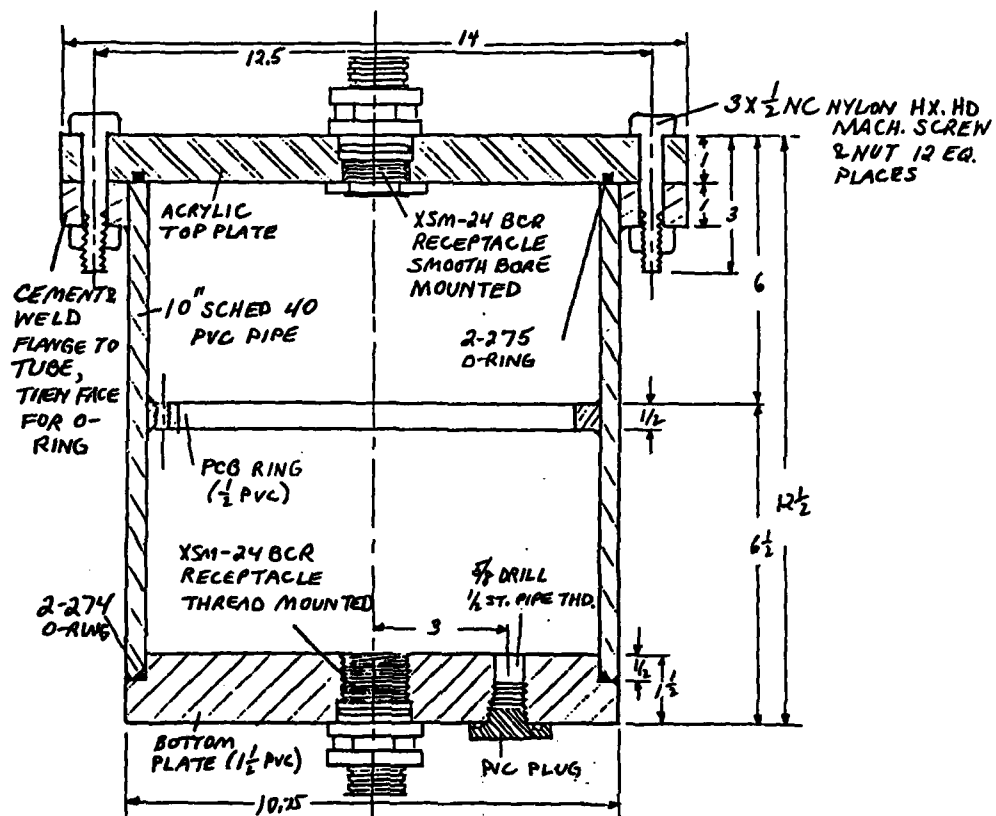


FIGURE 5-8

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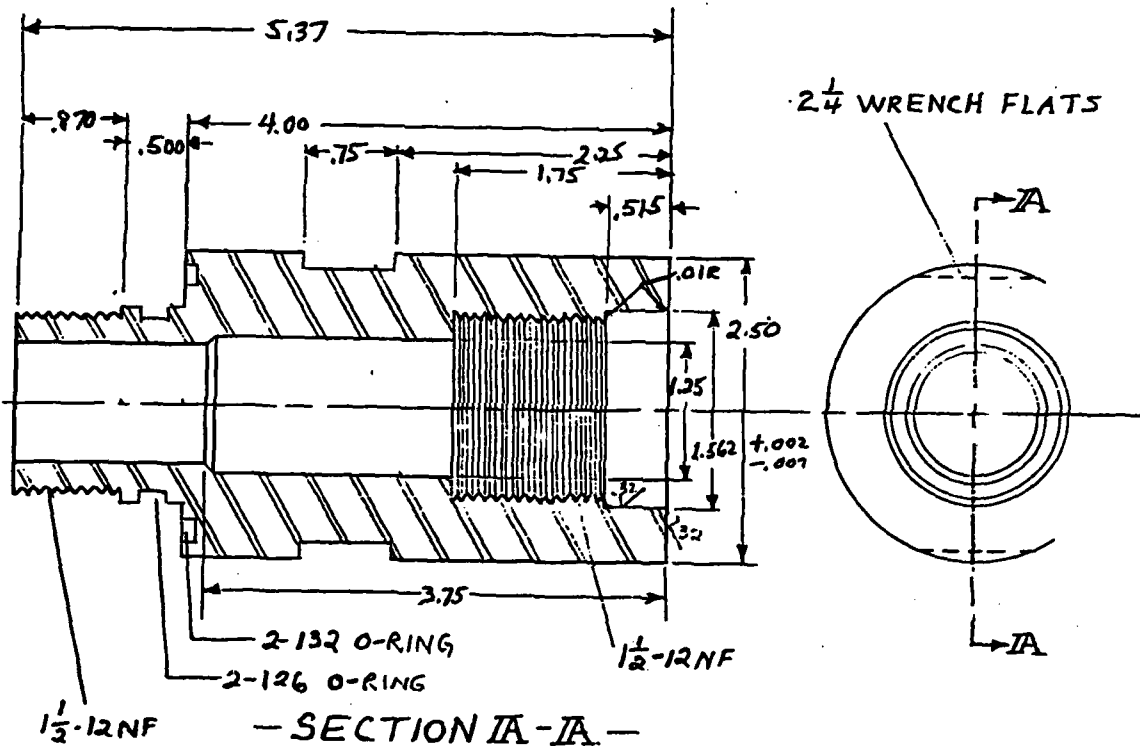
INTERMEDIATE FIELD A-TYPE SENSOR ELECTRONICS HOUSING ASSEMBLY

FIGURE 5-9

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ENGINEERING LABORATORY**

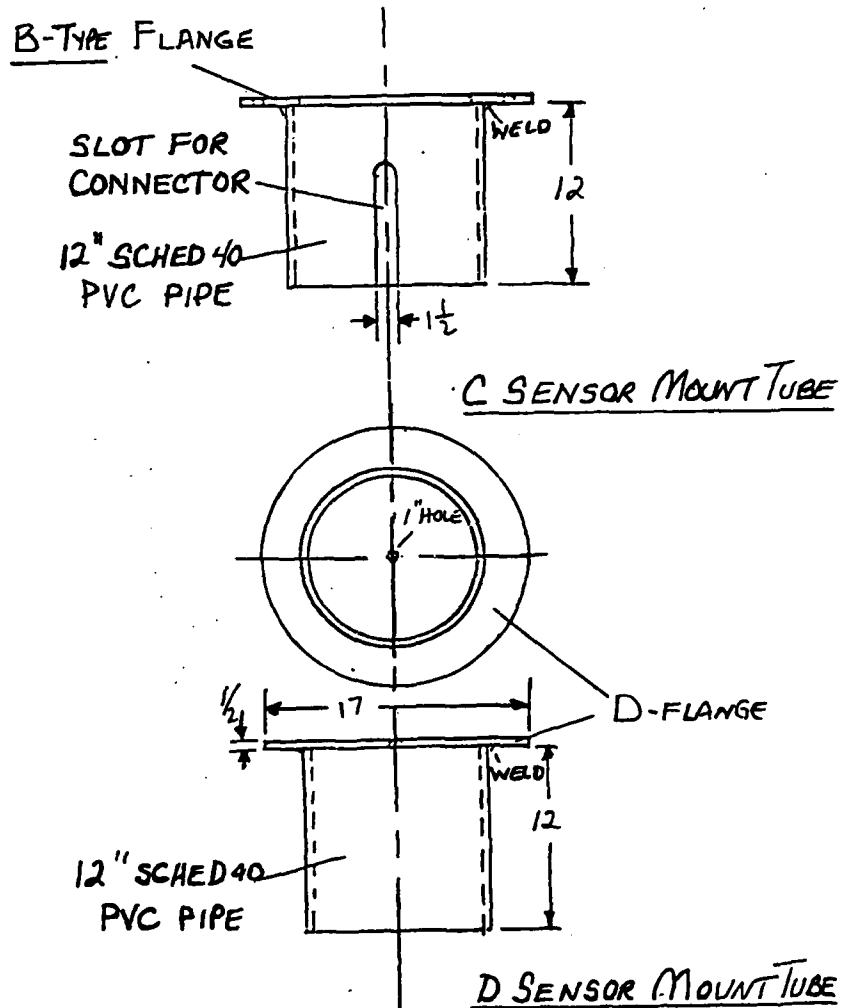
MATL: DELRIN

2 $\frac{1}{4}$ WRENCH FLATS



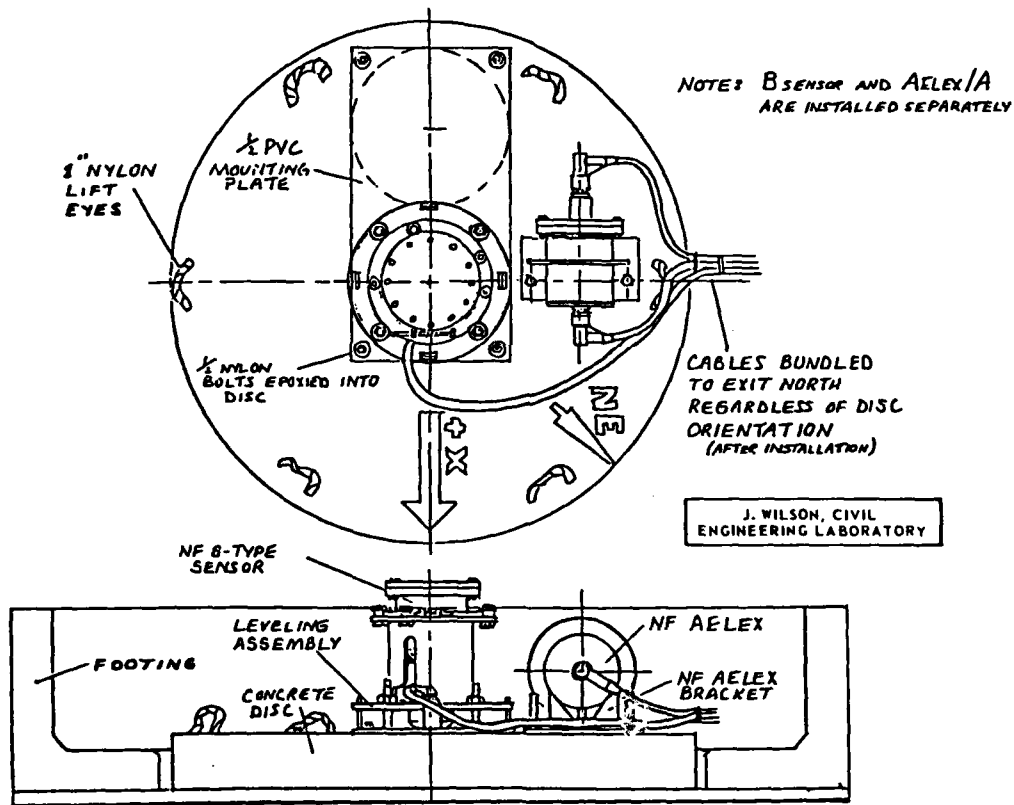
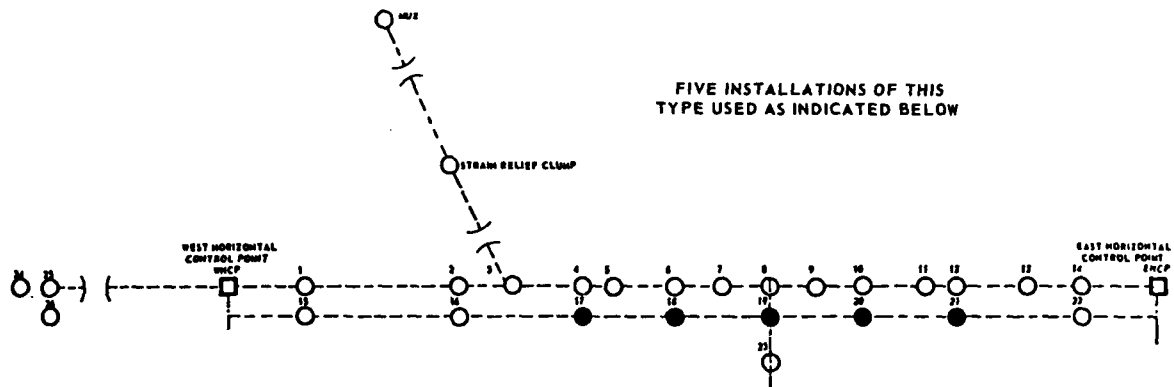
NEAR FIELD A-TYPE SENSOR ELECTRONICS HOUSING EXTENDER

FIGURE 5-10



C-TYPE AND D-TYPE SENSOR MOUNTING TUBES AND FLANGES

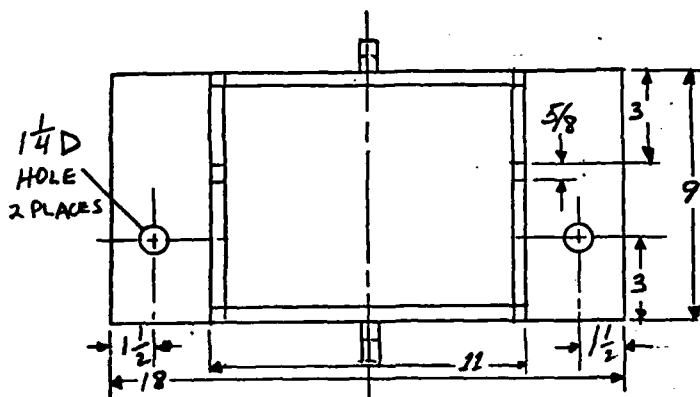
FIGURE 5-11



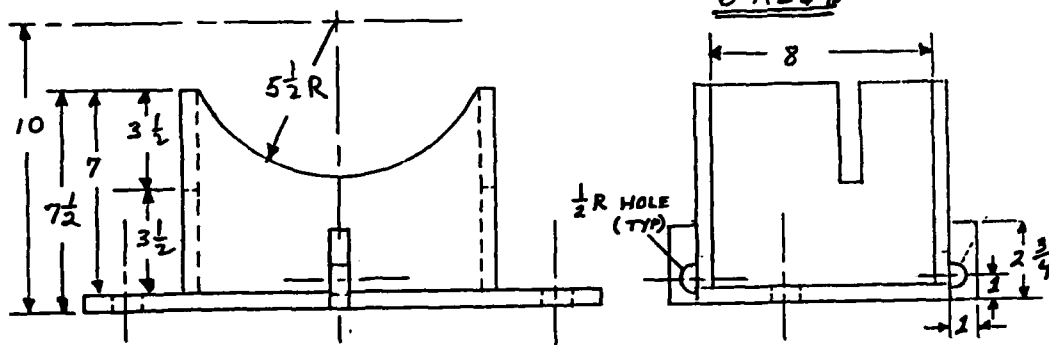
NEAR FIELD B-TYPE SENSOR WITH ELECTRONICS FOR NEAR FIELD A-TYPE SENSOR INSTALLED ON SAME CONCRETE DISC

FIGURE 5-12

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MATL: $\frac{1}{2}$ PVC, WELDED
6 REQ'D



NEAR FIELD A-TYPE SENSOR ELECTRONICS MOUNTING BRACKET

FIGURE 5-13

Intermediate Field B-Type Sensor, Multiplexer, and A-Type Electronics Assembly

As in the case of the near field, the intermediate field B-type sensor foundations contain an AELEX assembly. In addition, on the concrete discs in these foundations, a small multiplexer (MUX) unit is also mounted as shown in Figure 5-14. An assembly of the multiplexer housing containing the MUX unit is depicted in Figure 5-15. As can be seen, the housing is essentially a 48-inch length of 12-inch Schedule 40 PVC pipe capped with two end plates and fitted with internal brackets for mounting the MUX unit. The following details of the multiplexer housing and its mounting elements are also given:

Multiplexer Housing End Plate -----	Figure 5-16
Multiplexer Housing Flange -----	Figure 5-17
Multiplexer Housing Power Supply Mounting Bracket -----	Figure 5-18
Multiplexer Housing Power Supply Adapter -----	Figure 5-19
Multiplexer Mount Hole Patterns, A-End Mounting Brackets, and Mounting Segments -----	Figure 5-20
Multiplexer B-End Mounting Brackets and Mounting Segments -----	Figure 5-21
Multiplexer Housing: B-End View -----	Figure 5-22
Intermediate Field Multiplexer and A-type Sensor Double Bracket -----	Figure 5-23

6.0 INSTALLATION HARDWARE AND EQUIPMENT

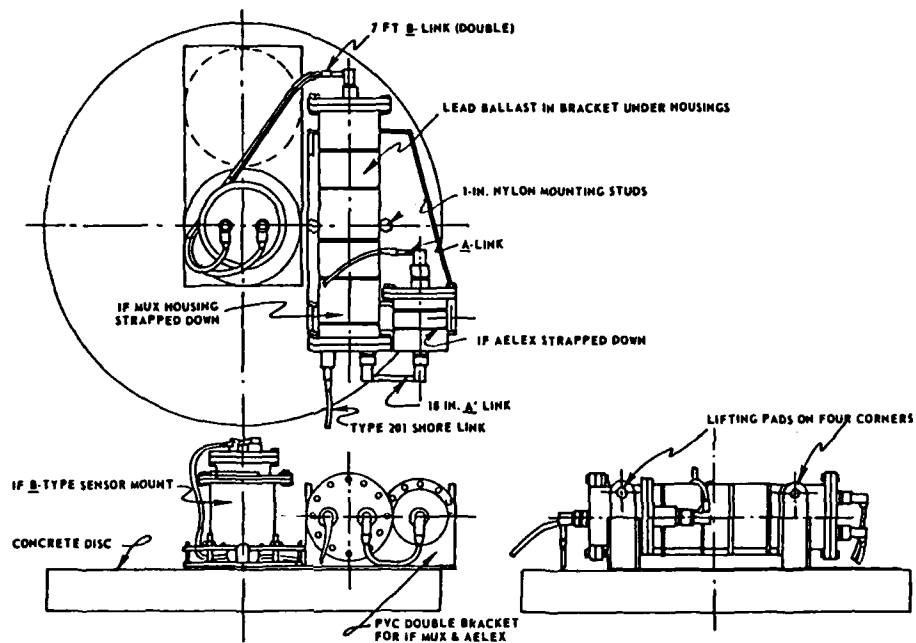
The installation of the Port Everglades Shallow Water Range called for precise geographical positioning of a number of sizeable pieces of hardware on the bottom in water depths averaging about sixty-five feet. The primary stipulation was that the lines of sensors be in an exact magnetic east-west orientation. Furthermore, their prescribed juxtaposition had to be met within close tolerances, the sensors had to be vertical, and the orientation of each sensor had to be within minute azimuth tolerances.

All of the sensor geographical positions had been predetermined to within a tenth of a foot with the results being tabulated in the Florida Grid, by latitude and longitude, by bearings from the theodolite stations, and by Mini-Ranger distances from the transducer locations. The ocean construction vessel *SEACON*, with its dynamic positioning capability supplemented by an anchoring system was to be used for the installation.

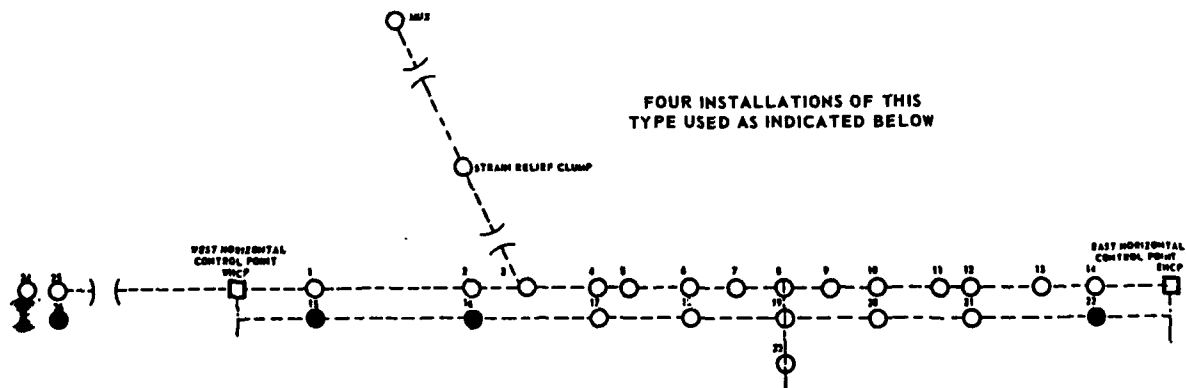
The general installation technique to be employed was to set a series of stakes, Figure 6-1, into the bottom with a stake driven in at the implant

INTERMEDIATE FIELD B-TYPE SENSOR WITH ELECTRONICS AND
MULTIPLEXER BOX FOR INTERMEDIATE FIELD A-TYPE SENSOR
INSTALLED ON SAME CONCRETE DISC

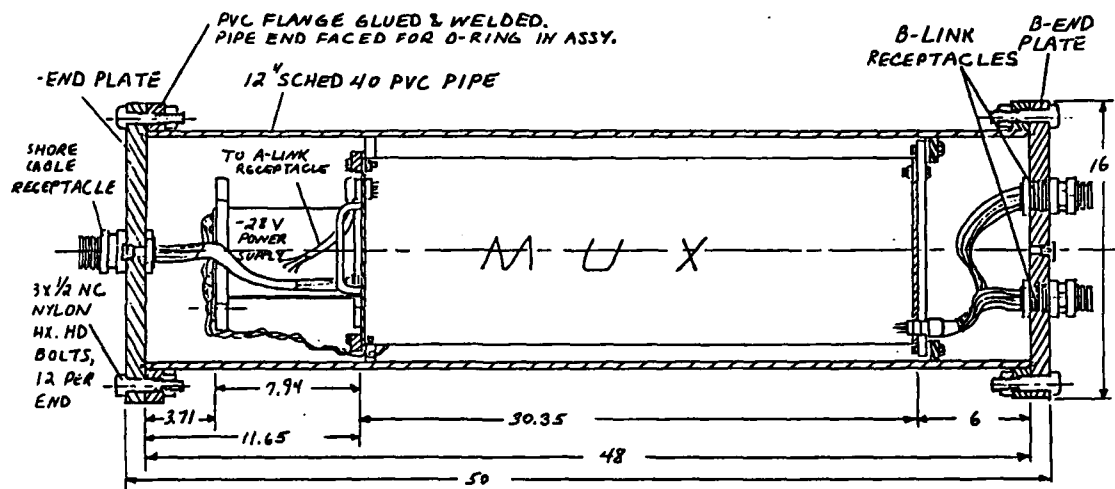
FIGURE 5-14



NOTE: MUX/AELEX, AND A ARE HARNESSSED SO THEY MUST BE LOWERED
AND RECOVERED TOGETHER, EXCEPT A MAY BE DETACHED FOR RECOVERY



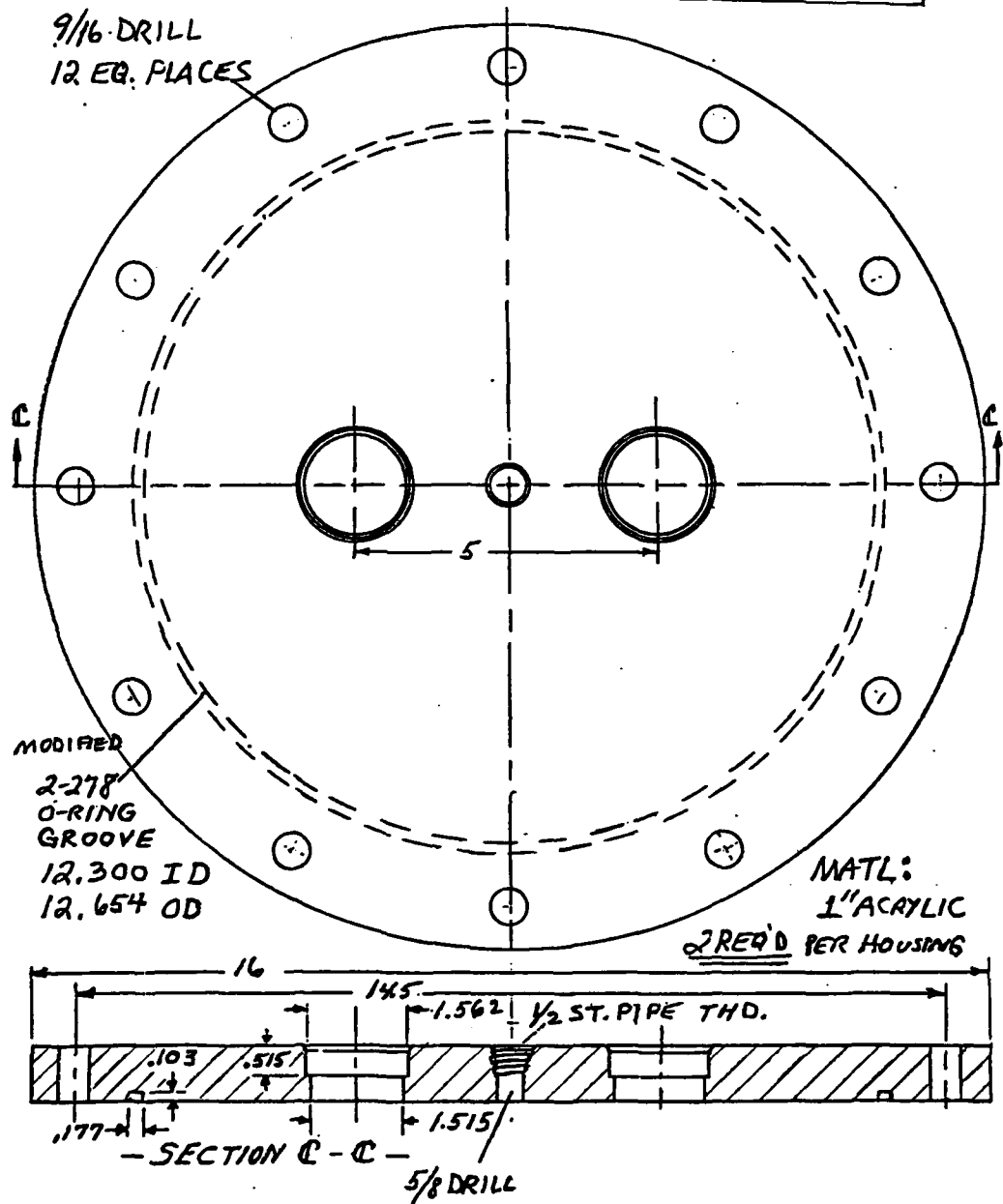
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INTERMEDIATE FIELD MULTIPLEXER HOUSING ASSEMBLY

FIGURE 5-15

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MULTIPLEXER HOUSING END PLATES

FIGURE S-16

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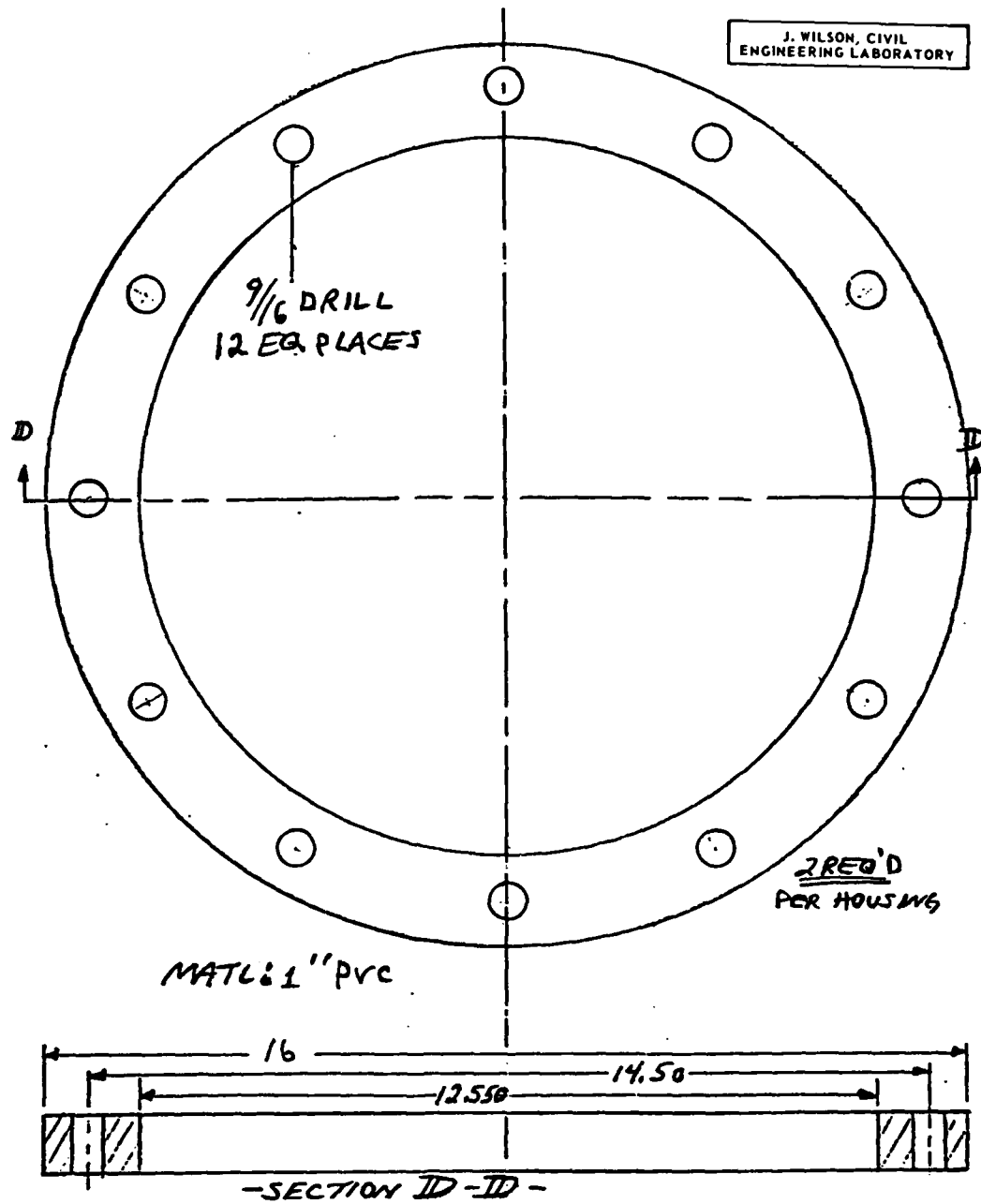
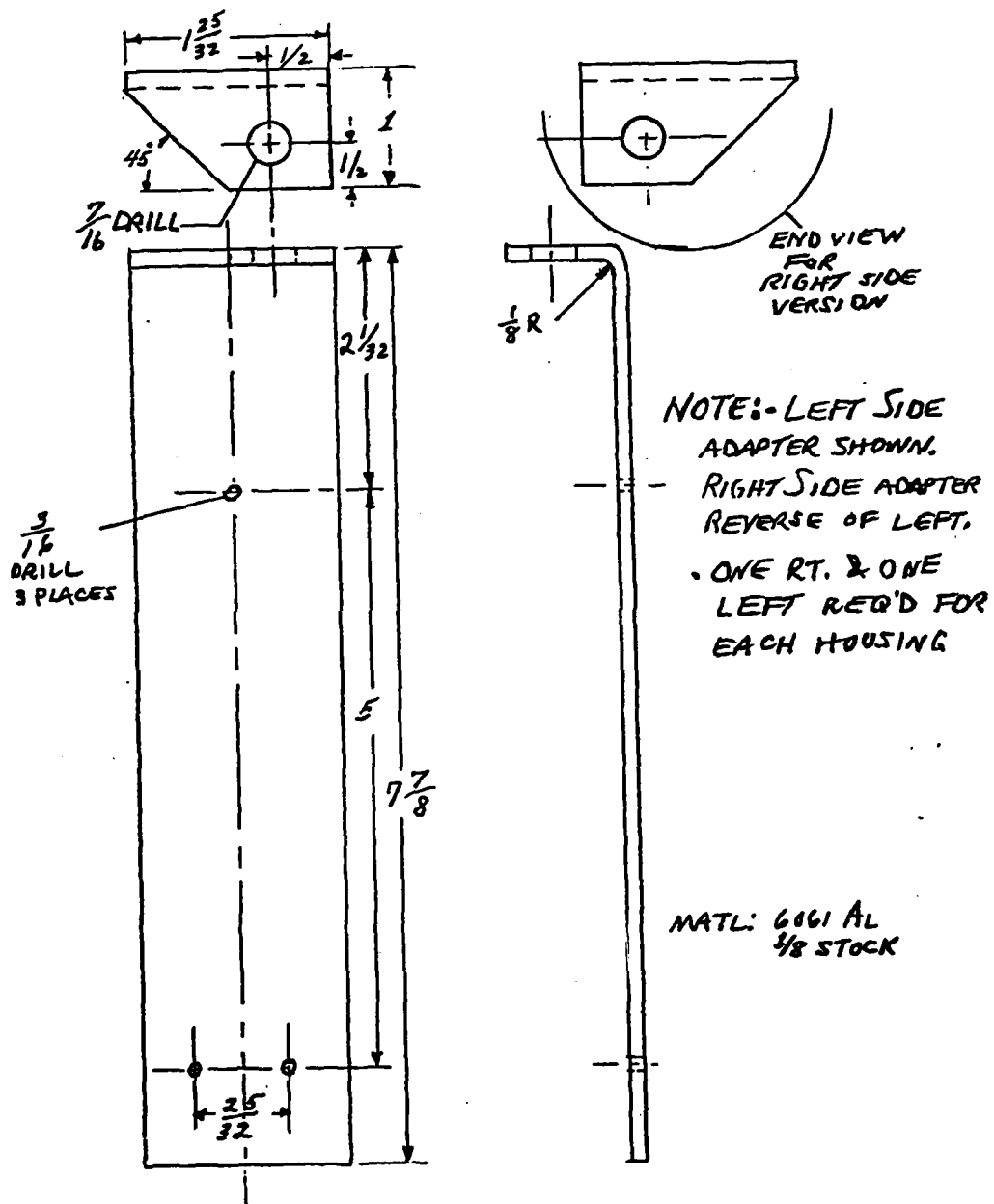


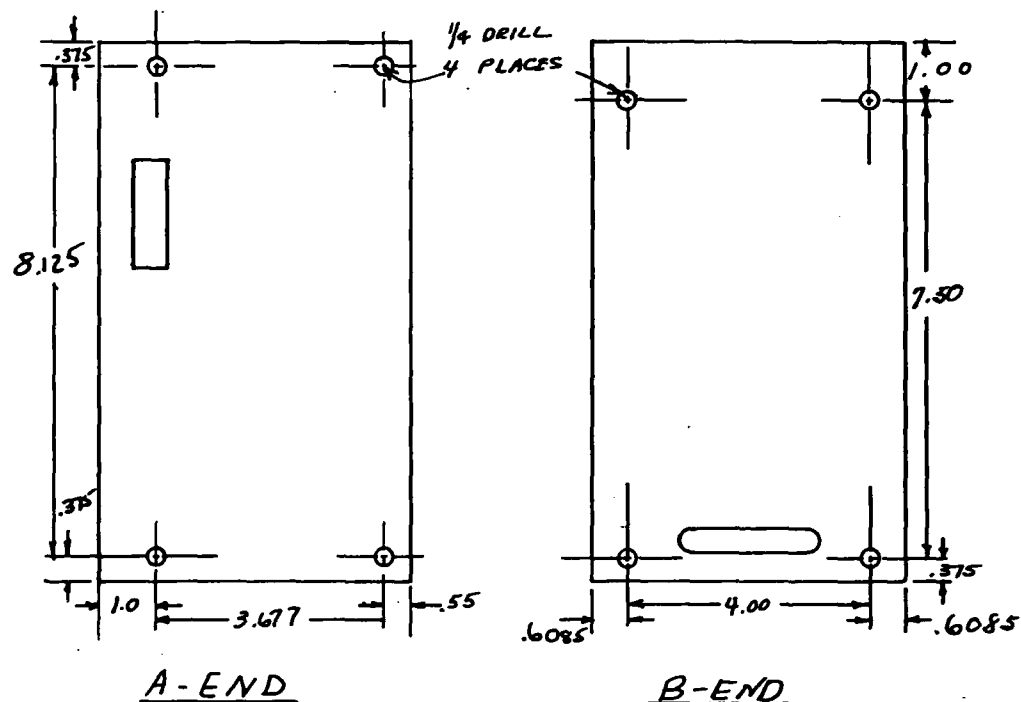
FIGURE S-17

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MULTIPLEXER HOUSING POWER SUPPLY ADAPTER

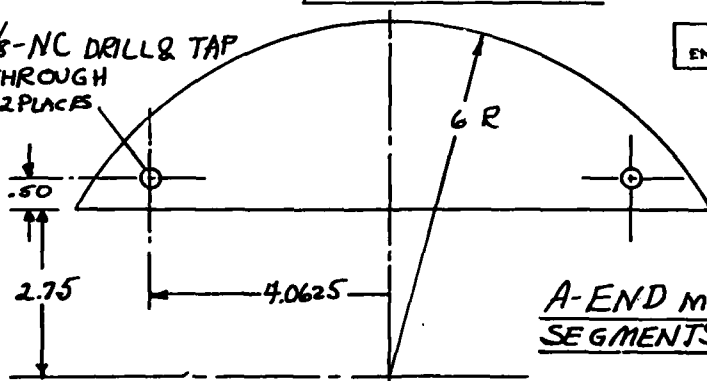
FIGURE 5-19



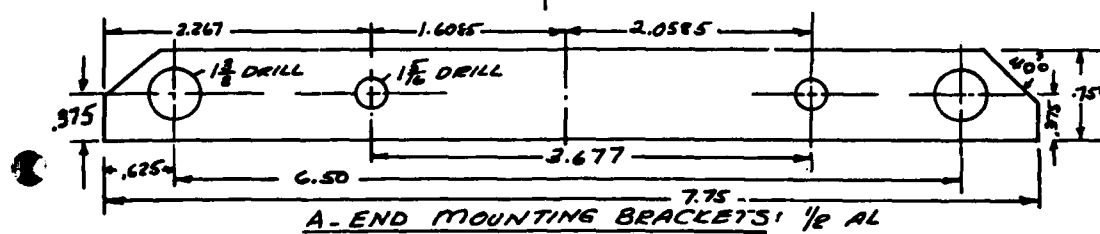
MUX MOUNT HOLE PATTERNS

3/8-NC DRILL & TAP
THROUGH
(2 PLACES)

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A-END MOUNTING
SEGMENTS: 1/2 PVC

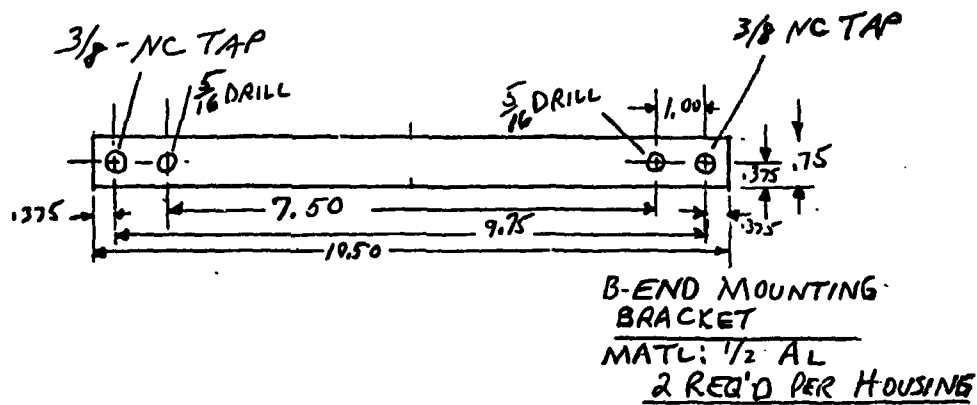
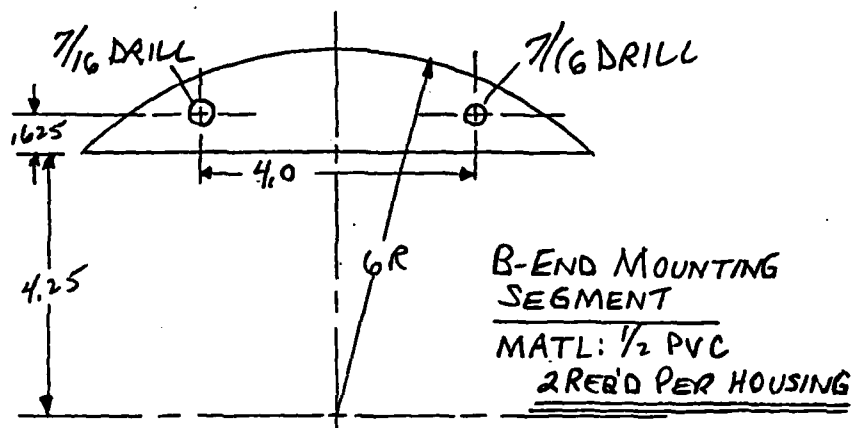


A-END MOUNTING BRACKETS: 1/2 AL

MULTIPLEXER MOUNT HOLE PATTERNS, A-END MOUNTING BRACKETS, AND MOUNTING SEGMENTS

FIGURE 5-20

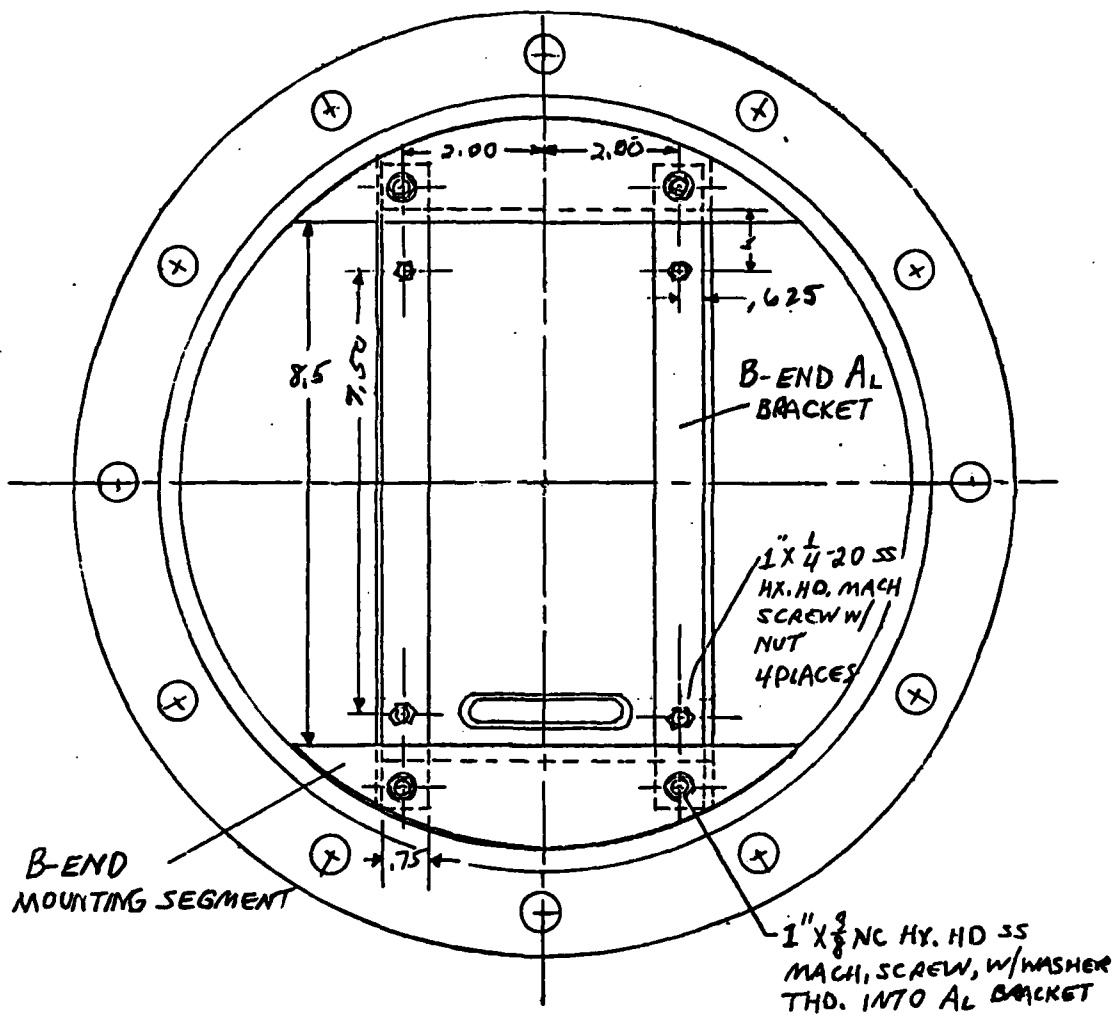
J. WILSON, CIVIL
ENGINEERING LABORATORY



MULTIPLEXER B-END MOUNTING BRACKETS AND MOUNTING SEGMENTS

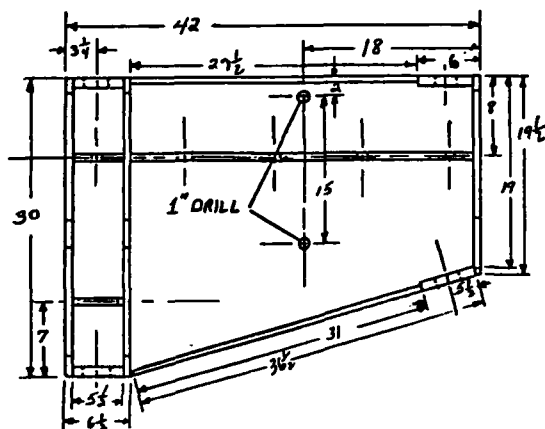
FIGURE 5-21

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MULTIPLEXER HOUSING: B-END VIEW

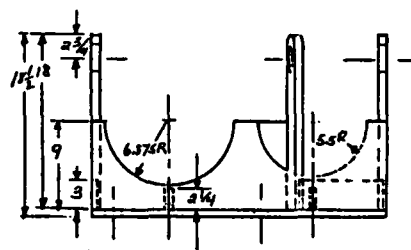
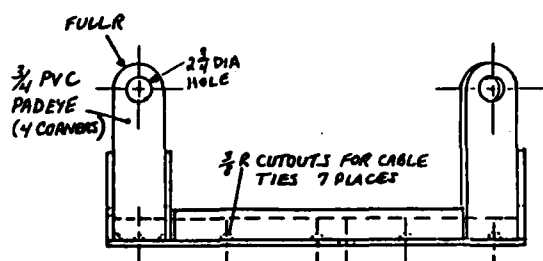
FIGURE 5-22



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ENGINEERING LABORATORY

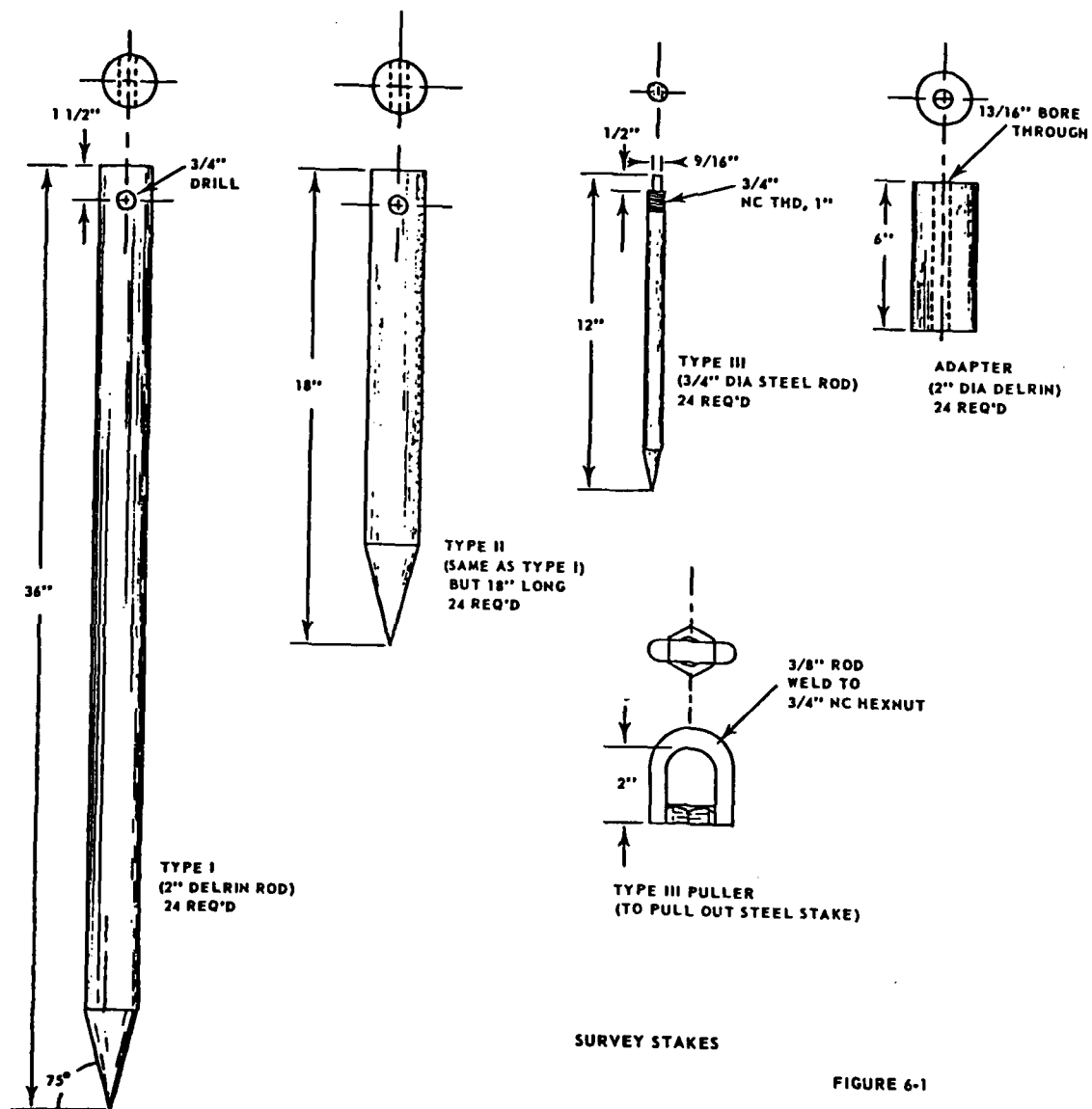
MATL: $\frac{1}{2}$ PVC EXCEPT PADEYES $\frac{3}{4}$
WELDED & GLUED

5 REQ'D



INTERMEDIATE FIELD MULTIPLEXER AND A-TYPE SENSOR DOUBLE BRACKET

FIGURE S-23



center of each unit of installation hardware and at the center of each sensor foundation. Centered on each of these stakes was a concrete guide cone, Figure 6-2, which served as a locator unit for the heavy equipment and hardware to be lowered down upon it.

Surveying the Array End Points

The surveying technique, for the end points of the array, described in detail in the Construction Operations Plan, is briefly related here to illustrate how the various items of installation hardware shown on the drawings were employed. The various position fixing methods described earlier could be counted upon to determine location at the water surface quite accurately; however, provision had to be made for transferring these coordinates from the water surface to the sea floor with no loss of accuracy.

The first step was to establish on the bottom the end points of the array. These were designated the east horizontal control point (EHCP) and the west horizontal control point (WHCP); the line connecting them was called the horizontal control line (HCL). To set the EHCP and the WHCP the Civil Engineering Laboratory conceived a device known as the CEL Spar. This spar was a buoyant mast of sufficient length to reach from the bottom to well above the water surface. At the bottom it was connected by a universal joint to a heavy base which could be planted on the sea floor with the spar rising vertically to the surface, Figure 6-3. Details of the spar and base construction are given in Figures 6-4 and 6-5.

For surveying the end points the spar was lowered through the well of the *SEACON* as illustrated in Figure 6-6 and the *SEACON* was positioned in the general location of the desired point by Mini-Ranger navigation and a heading was selected to minimize ship motion. Using the shore theodolites trained on the top of the mast, the *SEACON* could then be positioned to the desired location and the spar base lowered to the bottom and pinned in place by divers.

A measuring device was incorporated in the spar to determine the angle of the spar with the vertical in two orthogonal directions. Using the known position of the top of the mast, the length of the spar, and these two angles, the position of the spar base on the bottom relative to the specified position could then be calculated. This was done for numerous sightings over an extended period of time and the averages were used to determine the exact

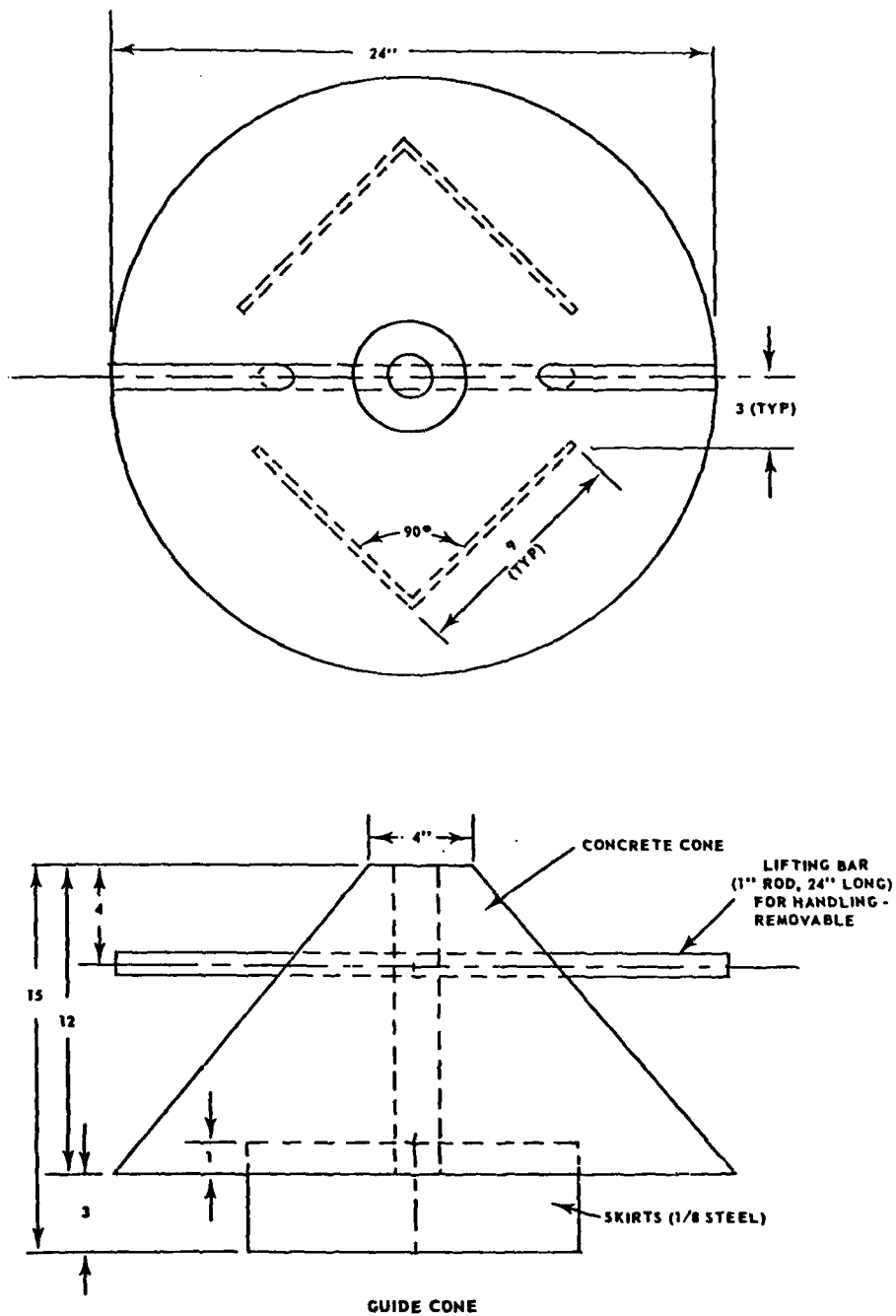


FIGURE 6-2

AD-A167 476

PORT EVERGLADES SHALLOW WATER RANGE AS-BUILT
DOCUMENTATION(U) NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON DC CHESAPEAKE DIV JAN 81... 85 DEC 85
CHES/NAUFAC-FPO-8138

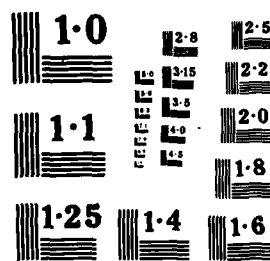
2/2

UNCLASSIFIED

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END
DATE
FORMED
6-86
101



**BOTTOM OF THE SURVEY SPAR
AND CLUMP ANCHOR**

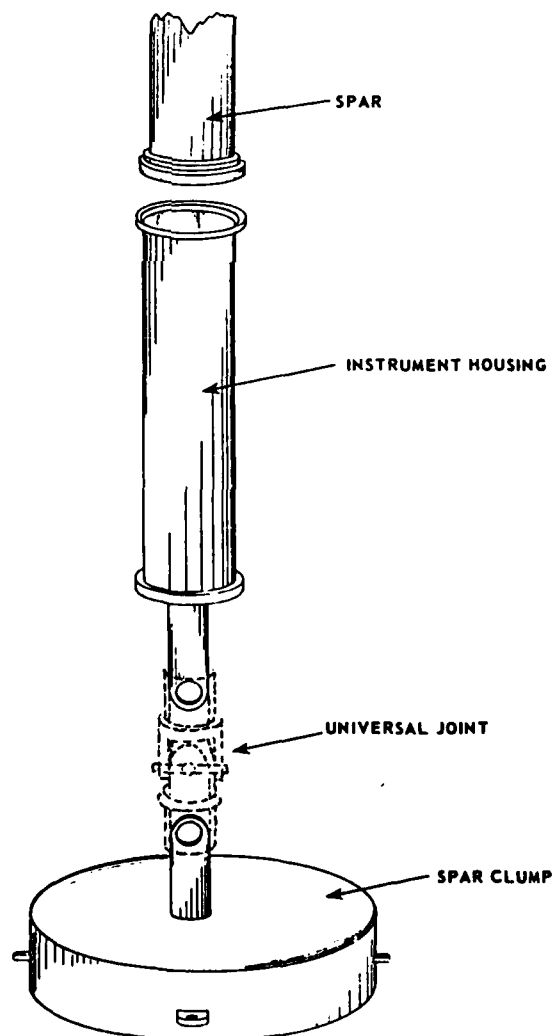
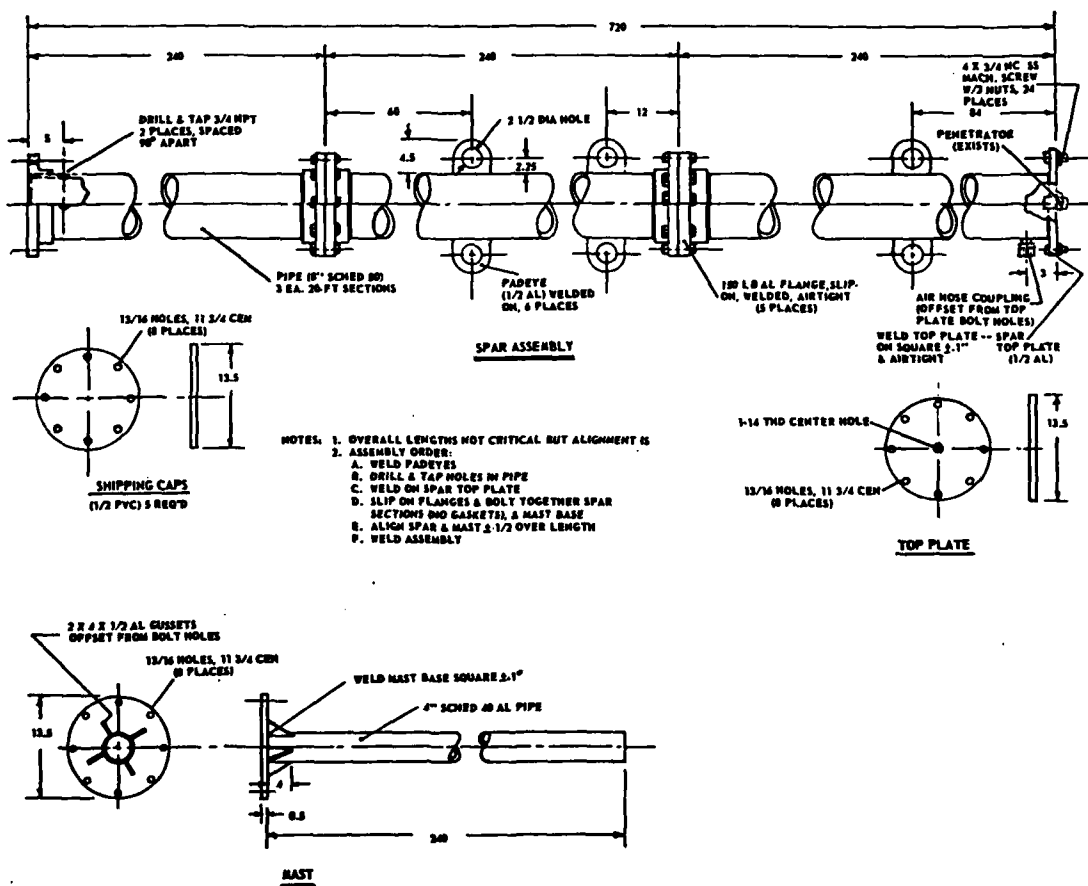


FIGURE 6-3



CONSTRUCTION DETAILS OF THE CEL SPAR

FIGURE 6-4

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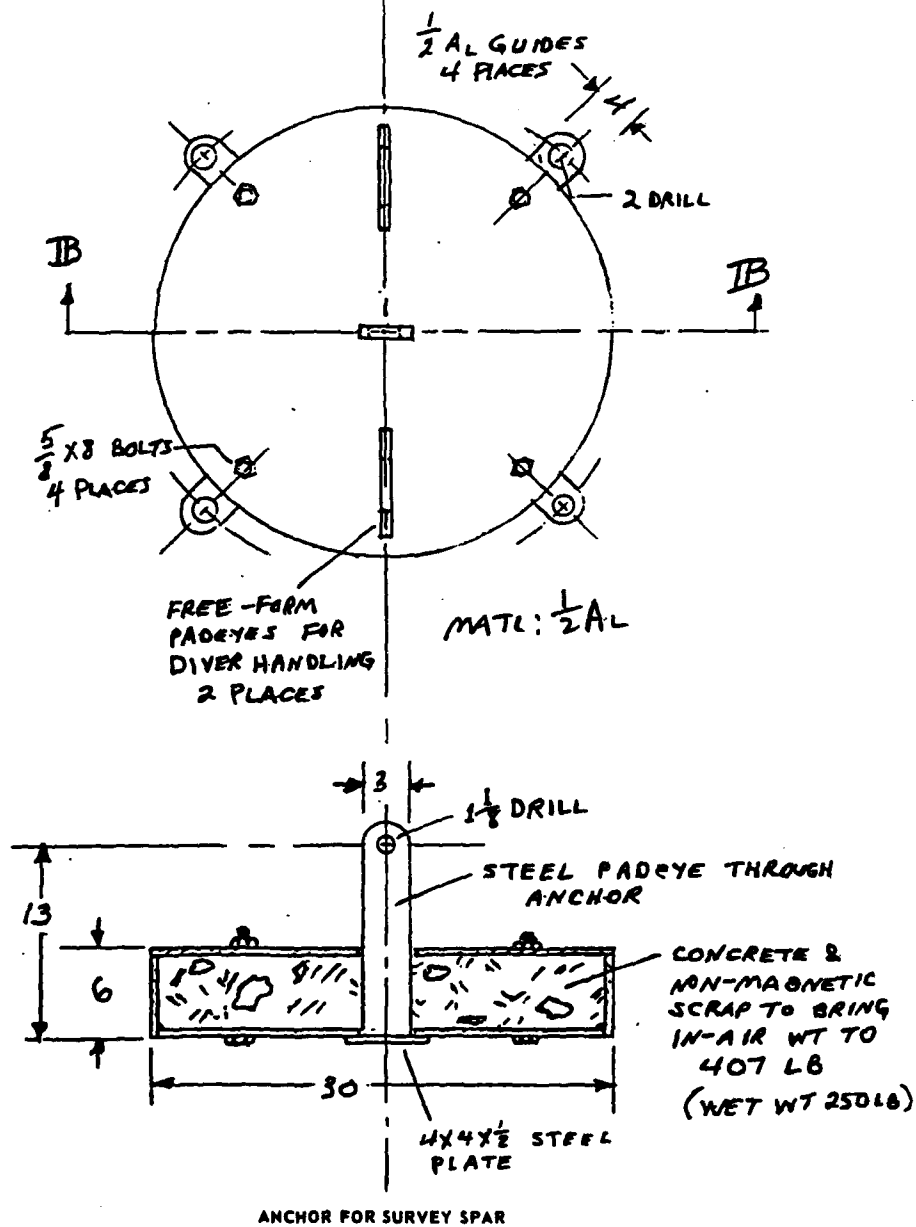
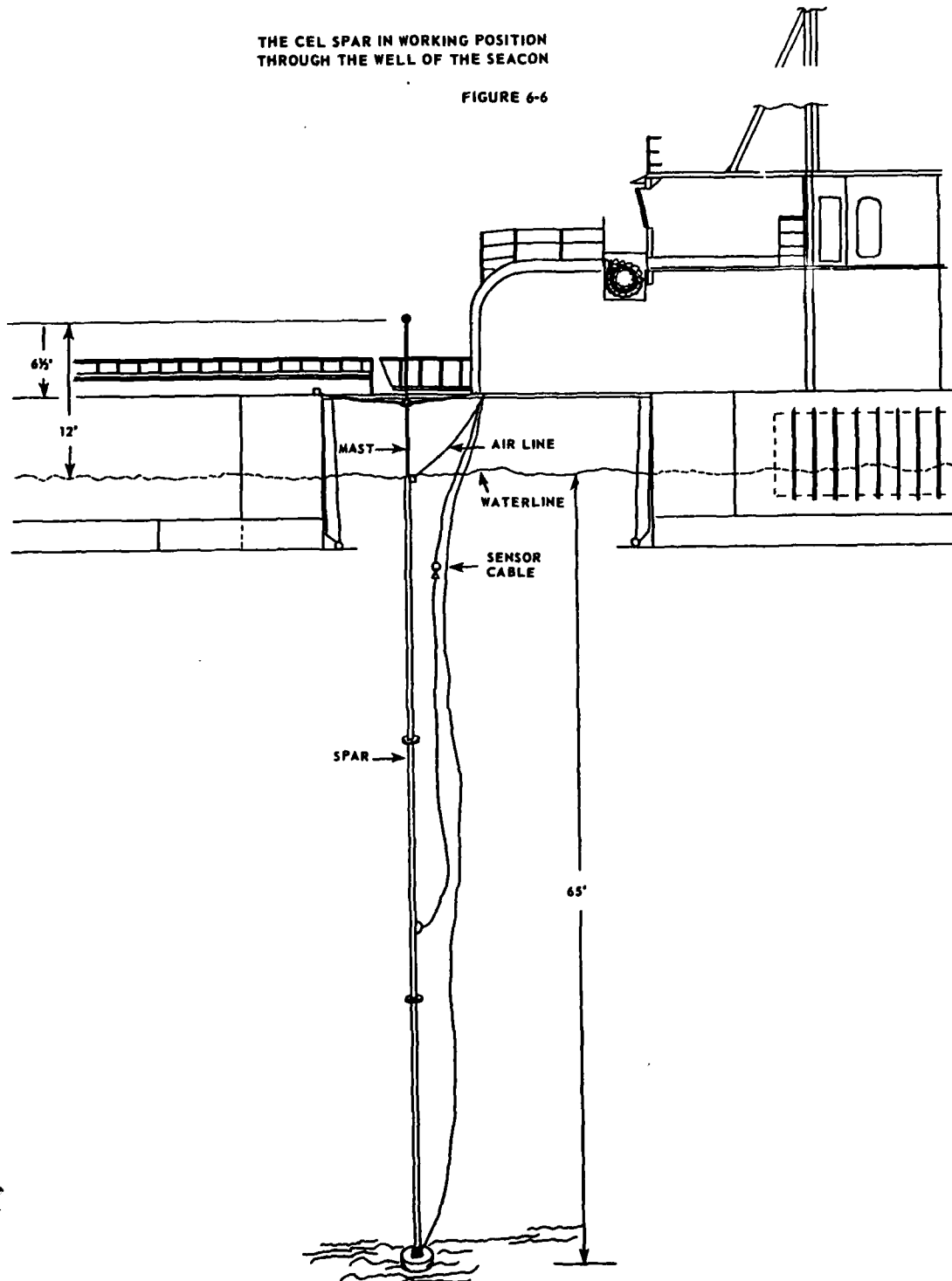
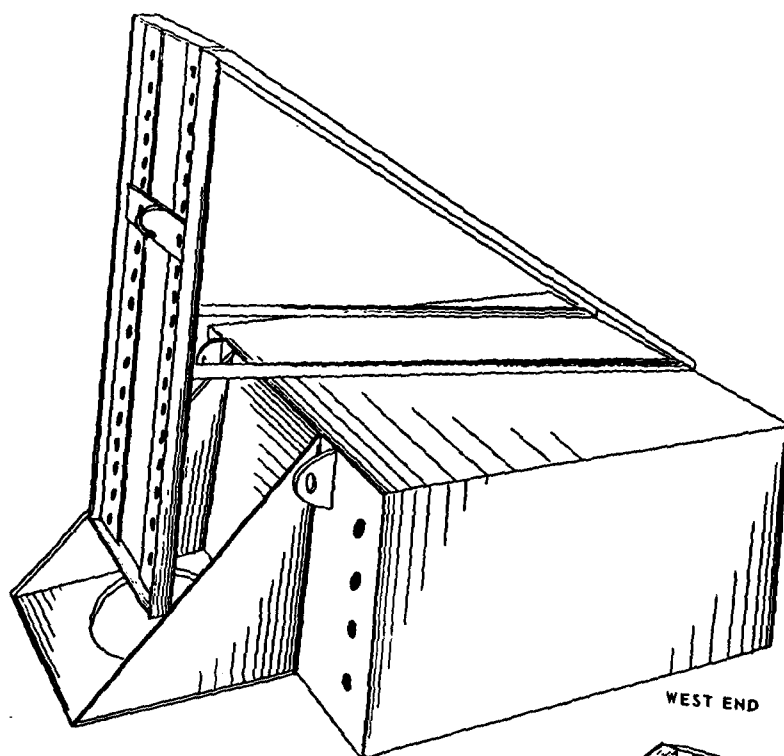


FIGURE 6-5

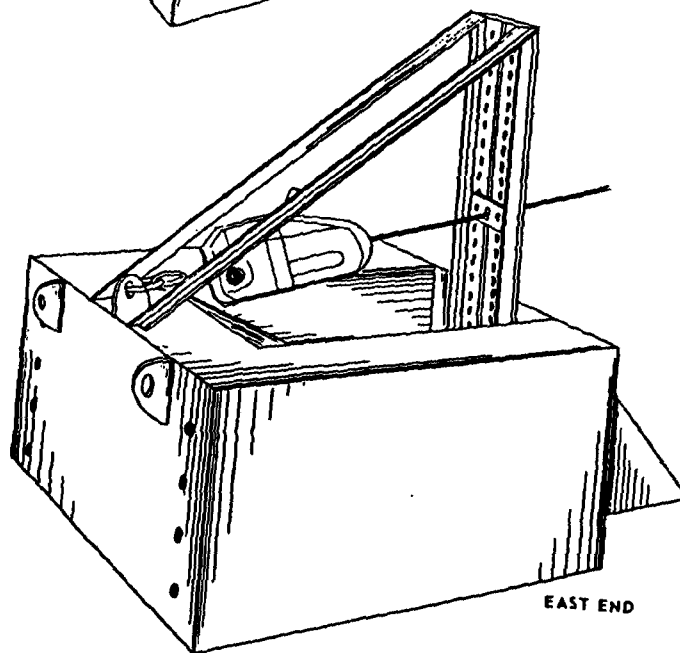
THE CEL SPAR IN WORKING POSITION
THROUGH THE WELL OF THE SEACON

FIGURE 6-6



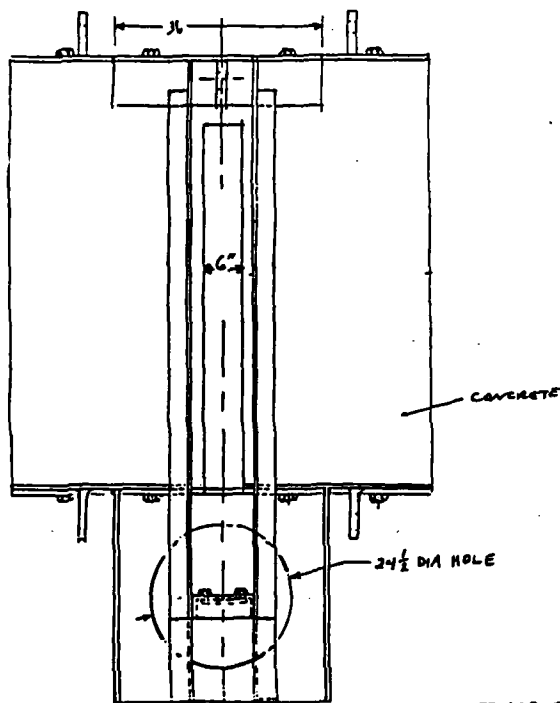


WEST END

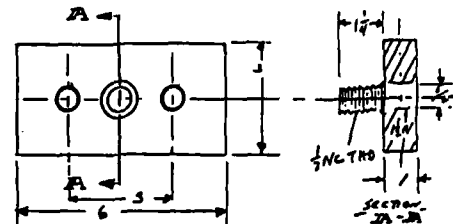


EAST END

HORIZONTAL CONTROL POINT CLUMPS



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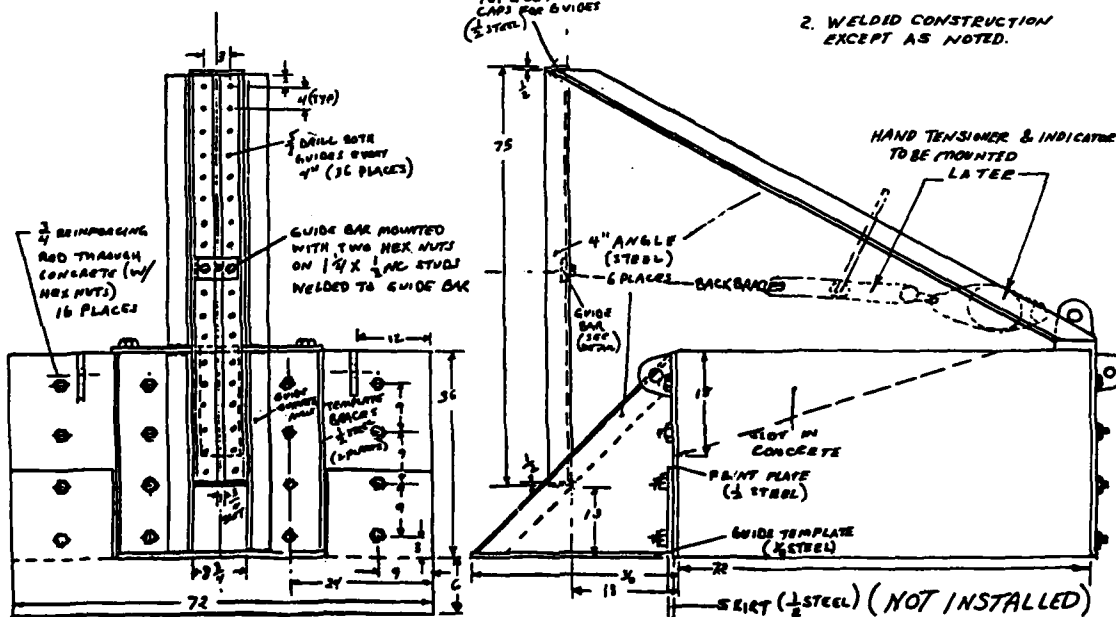


— GUIDE BAR DETAIL —

E HCP IDENTICAL
TO WHOP EXCEPT :

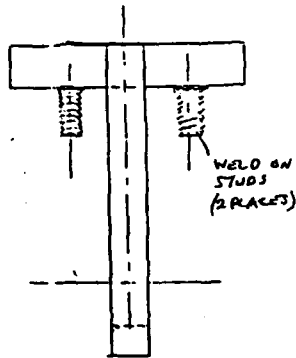
- A. NO WINCH MOUNT PLATE
- B. NO SLOT IN CONCRETE
- C. DIFFERENT D.E. BRACING
- D. MOVEABLE PAD EYE VS. GUIDE BAR

NOTE: 1. ALL METAL STEEL
2. WELDED CONSTRUCTION EXCEPT AS NOTED.



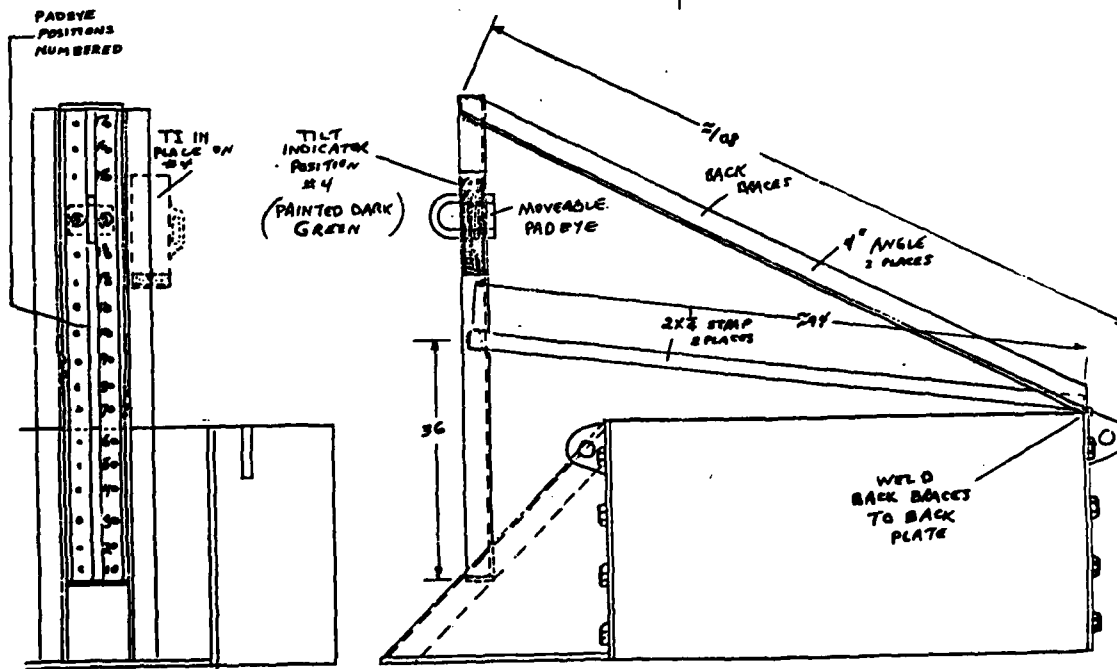
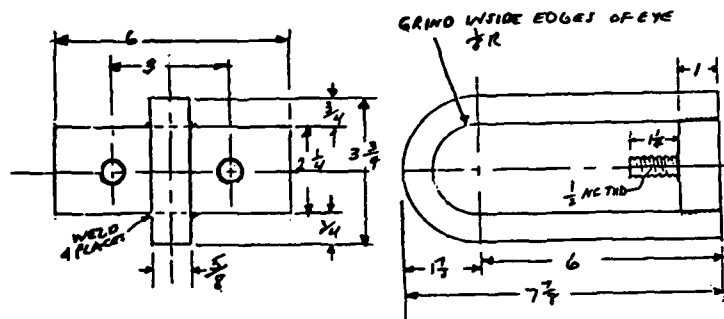
EAST HORIZONTAL CONTROL POINT ANCHOR CLUMP

FIGURE 6-8



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— MOVEABLE PAD EYE DETAIL —

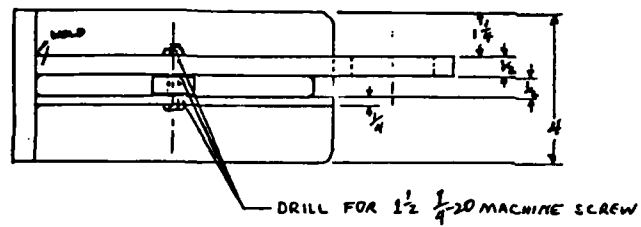


TILT INDICATOR POSITIONS ON HCP (WEST HCP SHOWN)

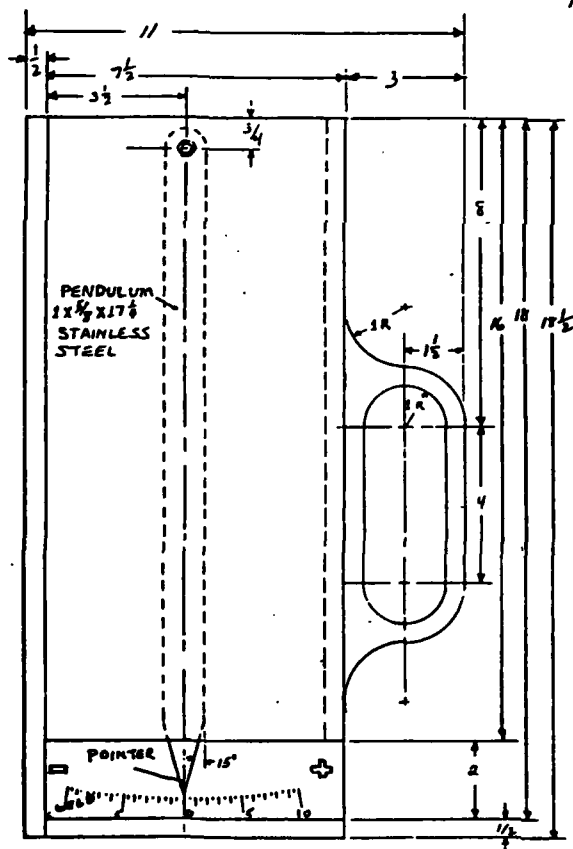
MOVEABLE PAD EYE DETAIL AND POSITIONS ON
WEST HORIZONTAL CONTROL POINT CLUMP

FIGURE 6-10

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NOTE: 1. ALL MAT'L PVC EXCEPT
PENDULUM & PIN



TILT INDICATOR

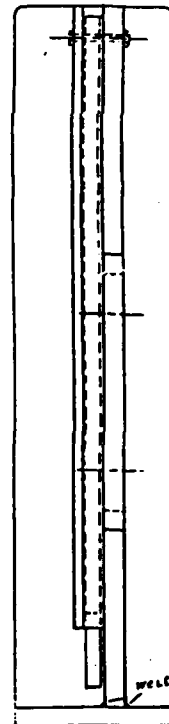
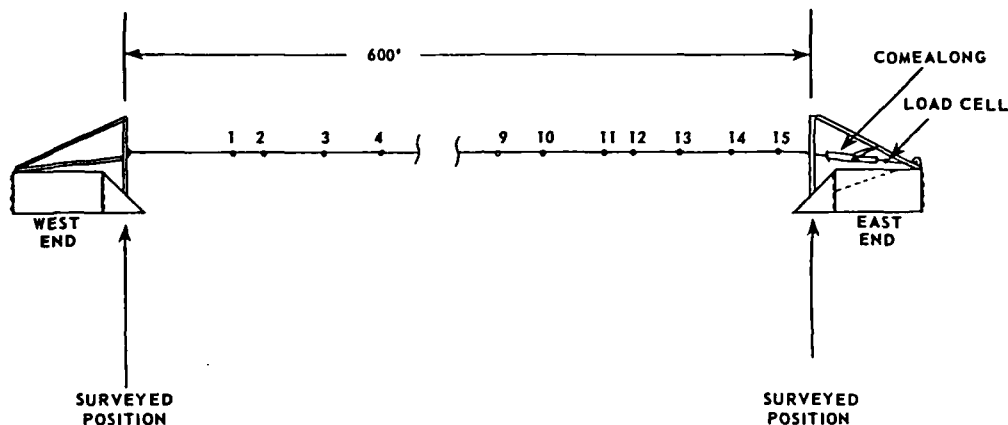


FIGURE 6-11

position of each horizontal control point. At these points stakes were driven and guide cones were set.

Establishing the Horizontal Control Line

The hardware that comprised the two horizontal control point units is depicted in Figure 6-7. These were heavy steel structures arranged to suspend the HCL at a series of adjustable heights and to pull the line up to a controlled tension. Construction details are shown in Figures 6-8 through 6-10. Note that a tilt indicator, Figure 6-11, was used to measure the tilt



HCL SECTIONAL VIEW LOOKING FROM SOUTH

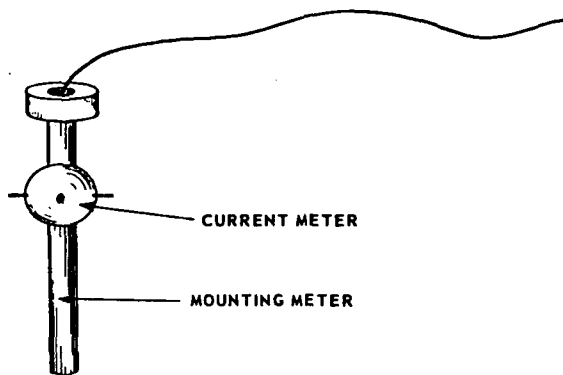
FIGURE 6-12

of the structure.

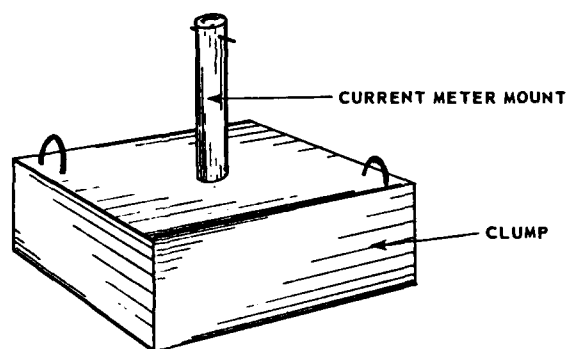
The HCL was premarked, Figure 6-12, for the new positions of all of the sensors along the north line between the EHCP and the WHCP. A horizontal catenary due to current could also exist and this would vary with the velocity of current flow. A current measuring device, Figure 6-13, was fitted with a mounting base to permit the current flow to be measured anywhere along the line and thus the horizontal catenary could be calculated.

Setting the Sensor Foundations

From the above calculations and data the desired location of the sensors



CURRENT METER



MOUNTING BASE FOR CURRENT METER

FIGURE 6-13

along the north line could be determined. Stakes were driven in at each point so determined and the guide cones were set on the stakes.

In order to set the positions of the south line of sensors, the north sensor locations were used as a guide. The rigging for this type of alignment process is shown in Figure 6-14. A PVC pipe assembly was fabricated with a Tee at each end; the Tees were centered exactly 20 feet apart. One end was fitted with a short length of PVC pipe that could be plugged into the top of a north sensor guide cone. Through the opposite end a stake could be driven. Fixed lengths of wire rope were fitted so that they would form the hypotenuse of a right triangle of such dimensions that the south line stake would be precisely south of the corresponding north line stake. After each south line stake had been driven in, a guide cone was placed over it.

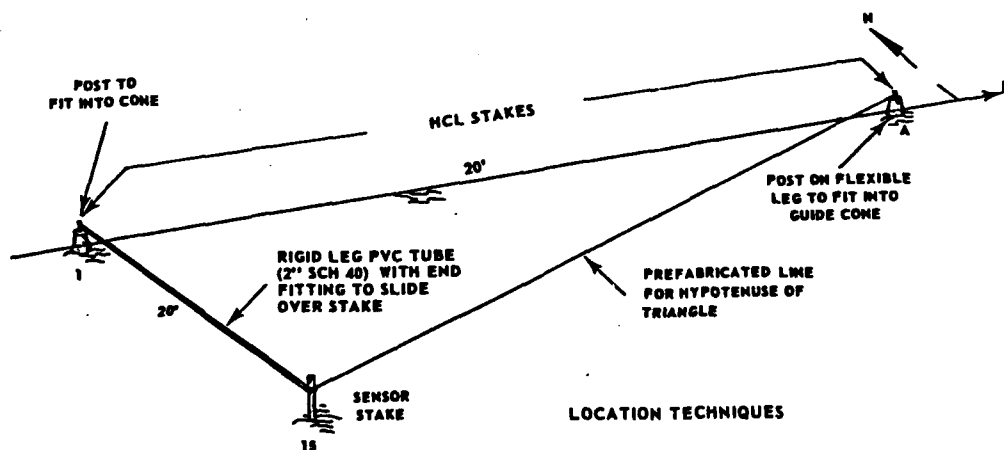
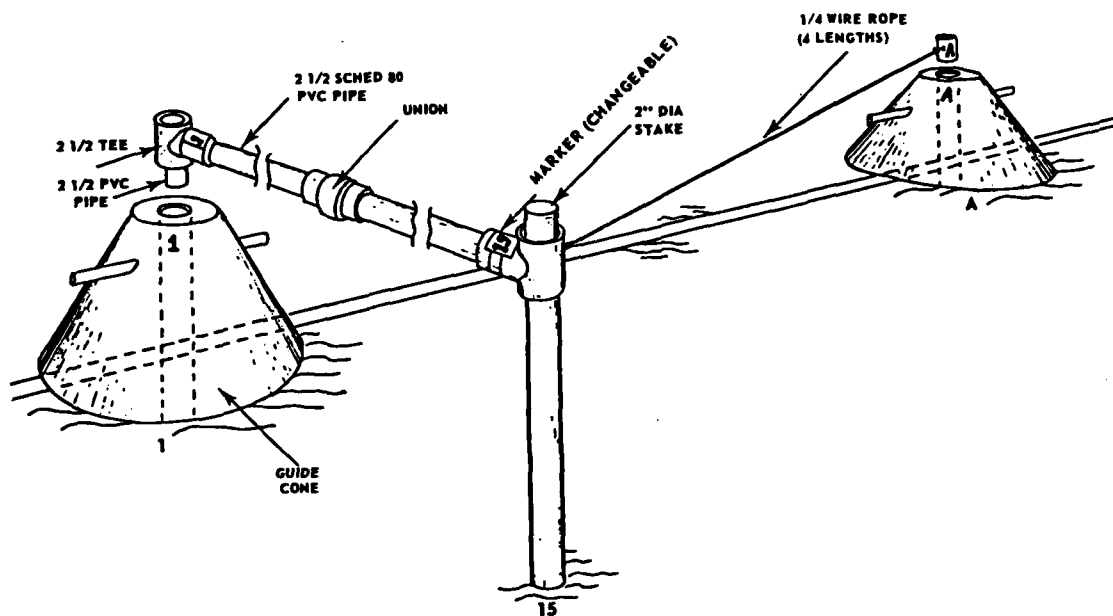
Once the guide cones were all in place the installation of the sensor foundations could begin. For each individual foundation the sensor supporting framework was installed, the concrete tub was lowered through the centerwell of the *SEACON*, and placed directly over its corresponding guide cone. For the lowering, a special handling hook was devised, Figure 6-15. This permitted maintaining the foundation in a level attitude and also provided for the mounting of a television camera, if required, which could be trained on the center of the foundation.

The foundation tubs were actually worked into place over the guide cones by divers while the tubs were suspended from the ship's crane as described in the Construction Operations Plan. After the foundations were properly centered upon the guide cones, the guide cones were removed and the sensor mounting frames were leveled.

Sensor Housing Alignment and Orientation

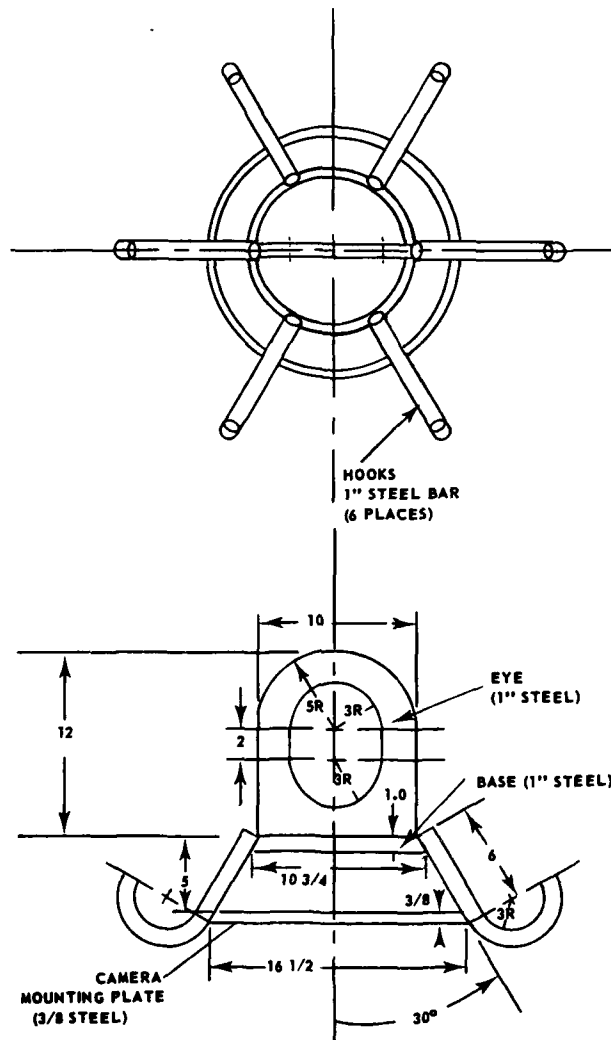
Before the sensor foundations were installed, the tension on the horizontal control line was released and the line allowed to settle on the bottom. After foundation installation, a second HCL was retensioned into position over the north line of sensor foundations to provide a reference for the sensor position.

Each sensor mount was fitted with a cover plate, Figure 6-16. Numbered concentric circles were inscribed on each plate so that the eccentric distance of the prescribed point on the HCL could be noted. A diver was required to hold a TV camera above the HCL and foundation so that the view



METHOD OF LOCATING SENSORS ALONG SOUTH LINE

FIGURE 6-14



SENSOR FOUNDATION HANDLING HOOK

FIGURE 6-15

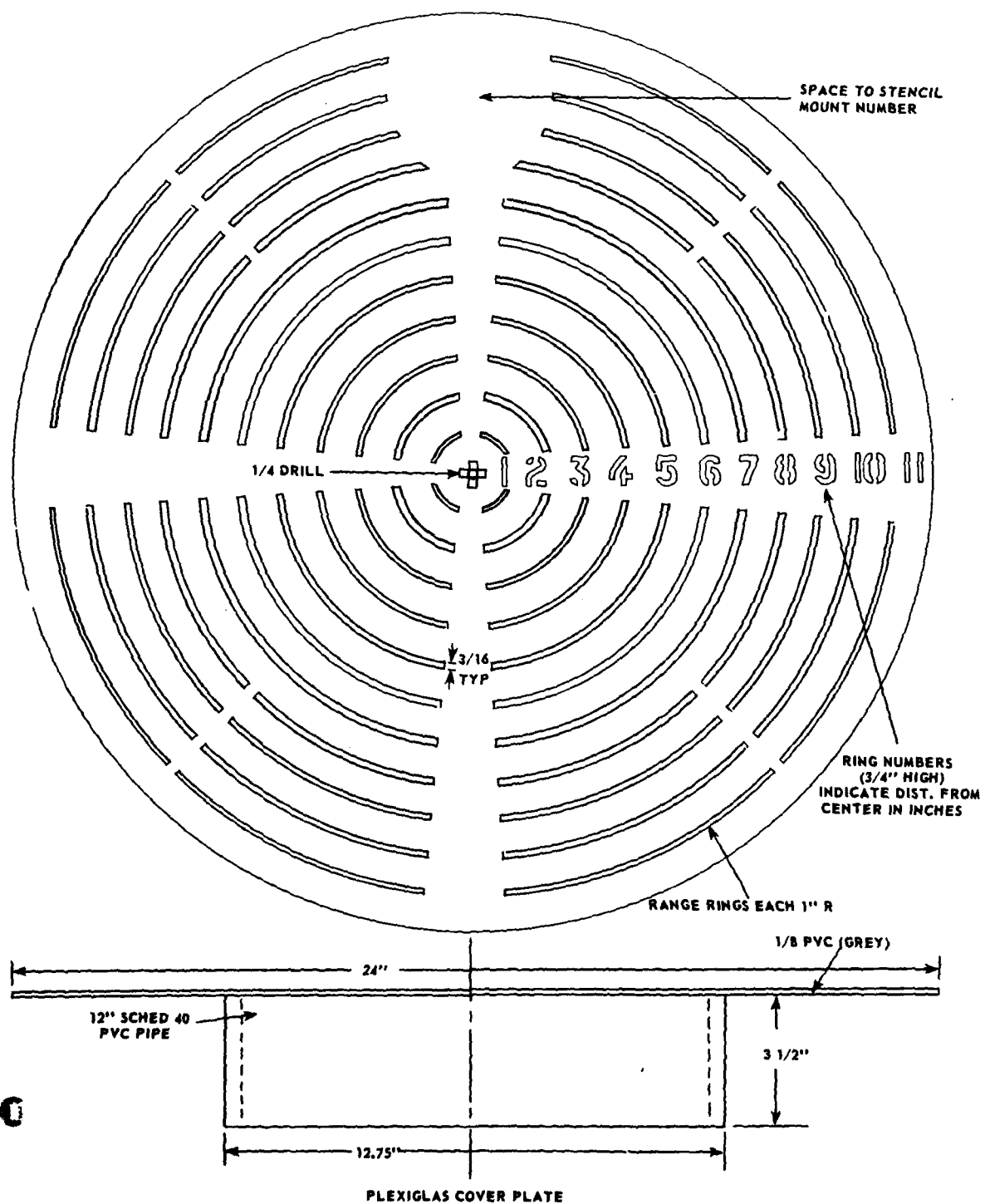


FIGURE 6-16

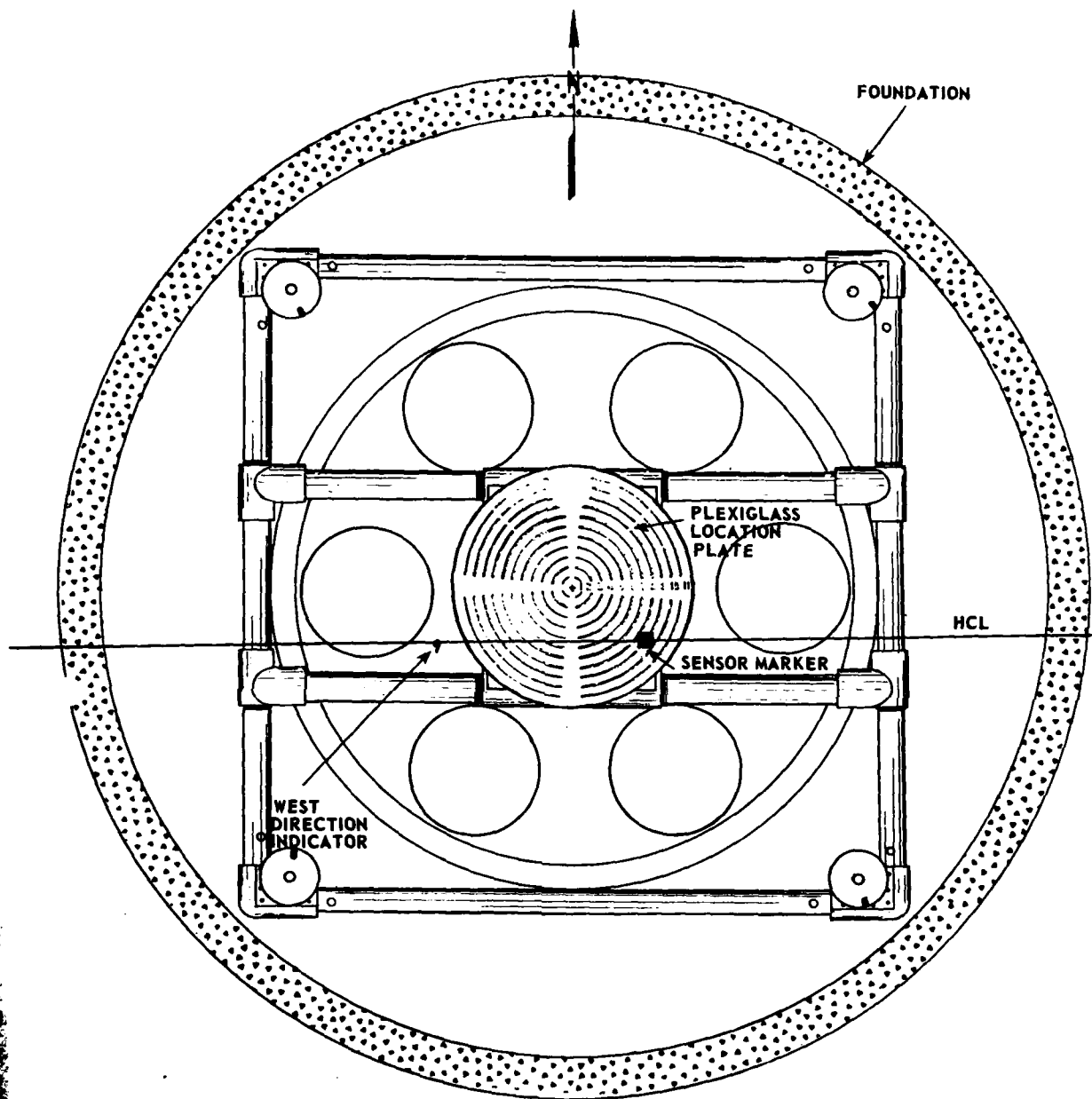
shown in Figure 6-17 could be recorded. This view, together with current meter data, allowed the range and bearing of the marker to the sensor center to be interpreted topside and the necessary adjustments to be made in the supporting framework.

Another device, conceived as an additional aid in the positioning process, was a tri-square, Figure 6-18 that could be used in addition to the TV representation in determining the offset of the sensor marker from the center of the sensor foundation.

The sensor mounting pipe frames were initially installed in all 26 foundations and the foregoing alignment procedures were carried out. However, a total of 13 mounting pipe frames were replaced with concrete discs on which the sensors, electronics packages, and MUX boxes were mounted. For these latter 13 units, the pipe frame mounting bolts were disconnected and the frames lifted aboard the installing ship. The horizontal location information was then transferred to the PVC plate on the mounting concrete disc and the sensor bases were glued and welded in place. An arrow was inscribed on the mounting disc to ensure that the proper azimuth would be retained during reinstallation.

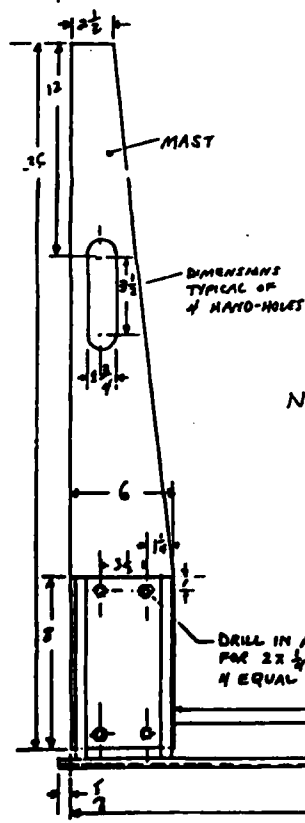
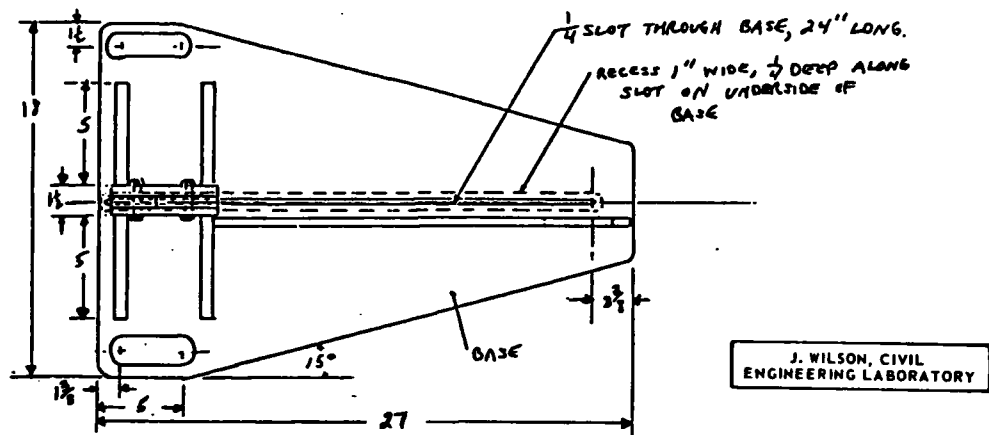
Lowering Sensors, Electronics Packages, and Multiplexers

In order to prevent damage to the sensors and other gear when being lowered to the bottom, a special handling platform was fabricated. The design of this platform and its hoisting slings are evident in Figure 6-19 and 6-20. This platform was used for the Intermediate Field sensor installation.



TV CAMERA VIEW LOOKING DOWN ON HCL
SENSOR LOCATOR AND LOCATION PLATE

FIGURE 6-17

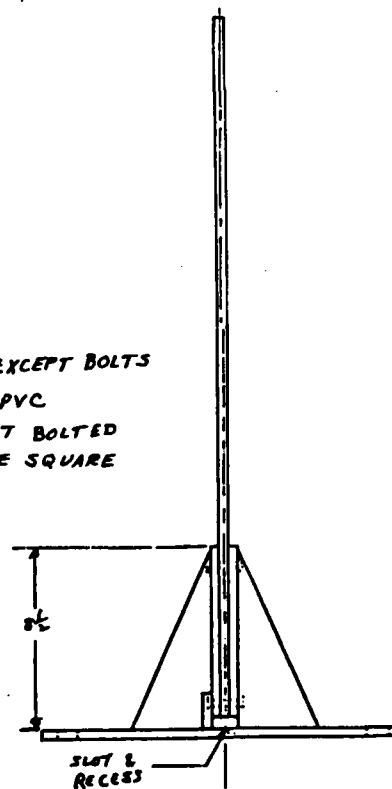


NOTE: 1. ALL MATL $\frac{1}{2}$ PVC EXCEPT BOLTS
2. ALL CONSTRUCTION PVC WELD EXCEPT MAST BOLTED IN ASSY TO ENSURE SQUARE

DRILL IN ASSY FOR 2 X 1/4-20 ST BOLTS 4 EQUAL PLACES

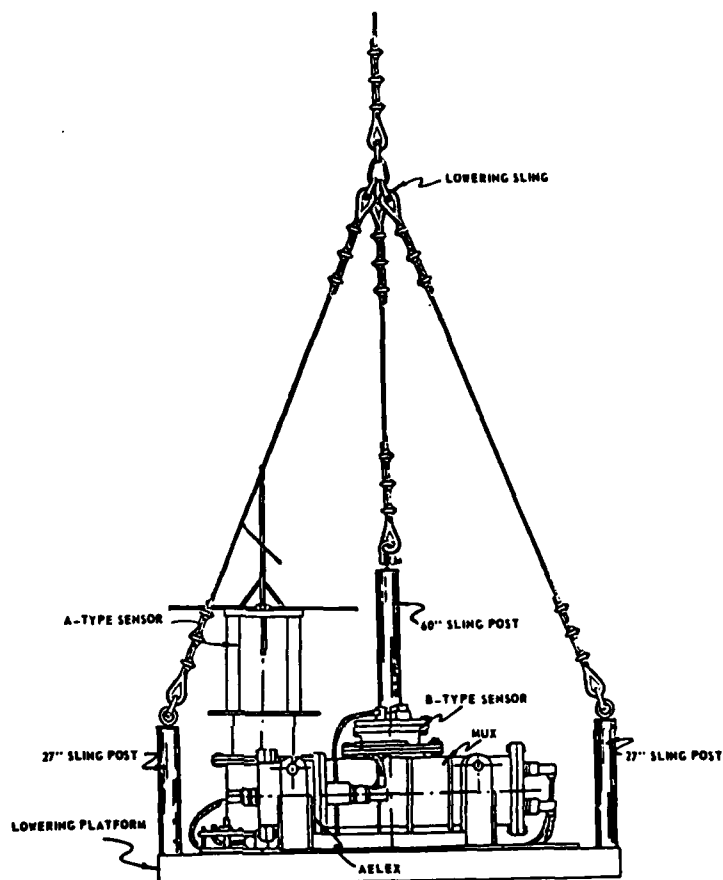
STIFFENER

24

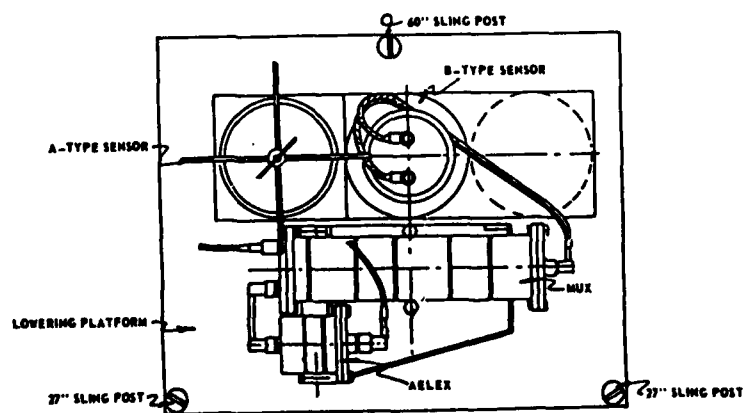


TRI-SQUARE DESIGN

FIGURE 6-18



ELEVATION



PLAN

ARRANGEMENT FOR LOWERING SENSORS TO BOTTOM

FIGURE 6-19

7.0 SCOUR PROTECTION RETROFIT

After the sensor foundations had been installed for some period of time, scour patterns were observed around the outside of the foundations and there was evidence of significant tilting of the foundations. After releveling of the sensors involved a scour protection system was devised for installation around all sensor foundations where tilt of the sensor could be deleterious.

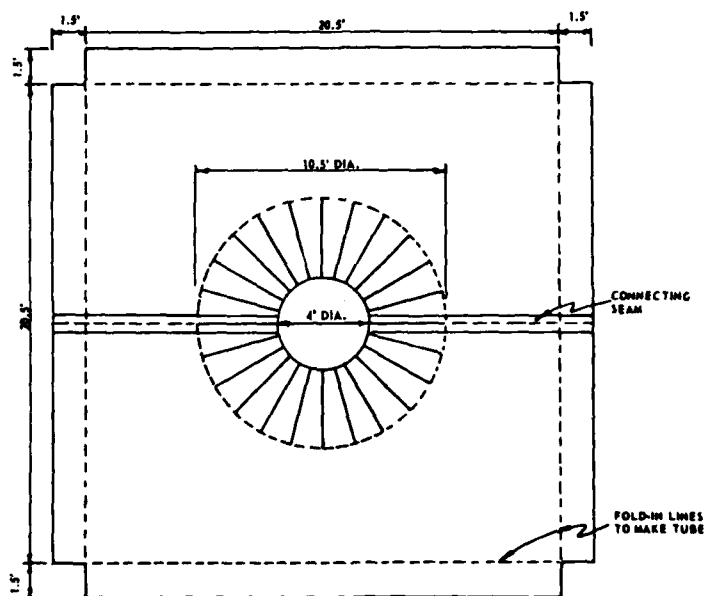
The scour blanket designed to protect each foundation was fabricated from poly vinylidene chloride fabric manufactured by Carthage Mills. This fabric met the Corps of Engineers guide specification CW 02215 of November 1977 for plastic filter fabric - Filter X - with an equivalent opening size or sieve number 100. The material was supplied in 12-foot rolls which were sewn together with a full length hem and the overall size for each blanket was trimmed to a 23.5 foot square.

As shown in Figure 7-1 an 18-inch square was cut out of each corner of the blanket so that the four sides could be folded inward to be hemmed to form tubular openings on the four sides of the square. Secondary tubes, 24 feet in length were sewn and inserted into the blanket side tubes. Draw-strings were sewn into each end of the tubes so that they could be closed off. The inner tubes were to be filled with sand to anchor the scour blanket to the bottom.

In the center of each scour blanket a 4 foot diameter hole was cut and a concentric 10.5 foot diameter circle (the O.D of the foundation) was scribed on the material. As shown in Figure 7-1, a series of radial cuts were made in the material from the circular cut-out to the scribed line. Thus, the blanket was so configured that it could be placed over the foundation with the pie-shaped wedges of the material arranged vertically around the foundation sides. Tourniquets of nylon line and bungee cord were made up to hold the flaps of material in place on the sides of the foundation.

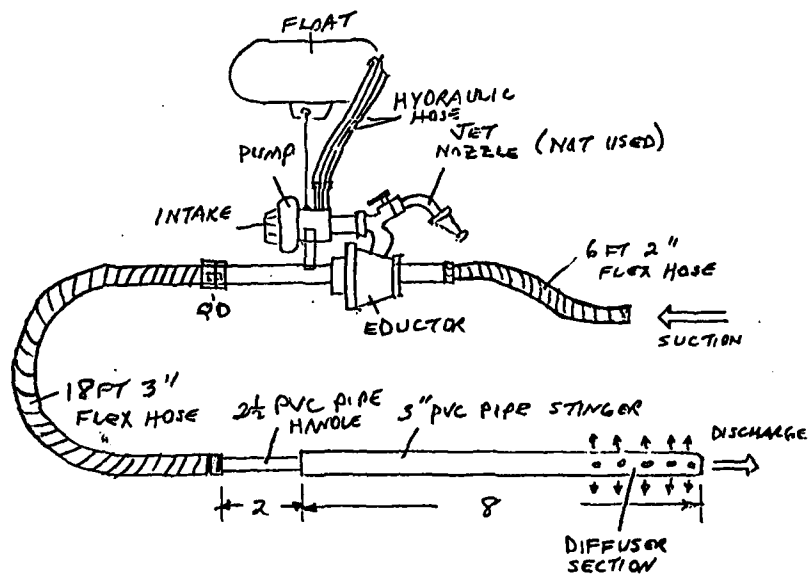
If one side of a foundation was raised above the bottom due to scour, sand was filled in around it to provide a relatively flat bed for installation of the scour blanket. The blanket was then fitted over the foundation and the flaps secured with the tourniquet. Also the blanket was flattened out along the bottom and the draw strings on one end of each tube were secured.

The gold dredge was rigged as shown in Figure 7-2 for filling the tubes. The diffuser section was inserted in each tube and the pump started with sand being sucked through the flexible hose and the eductor. As the sand and water mixture discharged into the filter fabric tube the water would leak out through the fabric leaving a deposit of sand as the pipe stinger was slowly retracted. If necessary, the draw string on the opposite end could be released and sand filled in from that end as well. When all four tubes were filled with sand, the draw strings were secured and the scour blanket installation was complete.



LAYOUT OF FABRIC FOR SCOUR BLANKET

FIGURE 7-1



GOLD DREDGE AS USED FOR FILLING
SCOUR BLANKET TUBES WITH SAND

FIGURE 7-2

END

DATE
FILMED

6-86